MITSUBISHI ELECTRIC

Changes for the Better

MITSUBISHI CNC

Specifications and Instruction Manual

Direct Drive Motor

IB-1501068(ENG)-B

Introduction

Thank you for selecting the Mitsubishi numerical control unit. This instruction manual describes the handling and caution points for using this AC servo/spindle.Incorrect handling may lead to unforeseen accidents, so always read this instruction manual thoroughly to ensure correct usage.
Make sure that this instruction manual is delivered to the end user. Always store this manual in a safe place.
In order to confirm if all function specifications described in this manual are applicable, refer to the specifications for each CNC.

Notes on Reading This Manual

(1) Since the description of this specification manual deals with NC in general, for the specifications of individual machine tools, refer to the manuals issued by the respective machine manufacturers. The "restrictions" and "available functions" described in the manuals issued by the machine manufacturers have precedence to those in this manual.
(2) This manual describes as many special operations as possible, but it should be kept in mind that items not mentioned in this manual cannot be performed.

Precautions for safety

Please read this manual and auxiliary documents before starting installation, operation, maintenance or inspection to ensure correct usage. Thoroughly understand the device, safety information and precautions before starting operation.
The safety precautions in this instruction manual are ranked as "WARNING" and "CAUTION".

⚠DANGER	**When there is a potential risk of fatal or serious injuries if handling is mistaken.**
⚠WARNING	**When a dangerous situation, or fatal or serious injuries may occur if handling is mistaken.**
⚠CAUTION	**When a dangerous situation may occur if handling is mistaken leading to medium or minor injuries, or physical damage.**

Note that some items described as "⚠CAUTION" may lead to major results depending on the situation. In any case, important information that must be observed is described.

The signs indicating prohibited and mandatory matters are explained below.

	Indicates a prohibited matter. For example, "Fire Prohibited" is indicated as .
	Indicates a mandatory matter. For example, grounding is indicated as .

The meaning of each pictorial sign is as follows.

CAUTION	**CAUTION rotated object**	**CAUTION HOT**	**Danger Electric shock risk**	**Danger explosive**
Prohibited	**Disassembly is prohibited**	**KEEP FIRE AWAY**	**General instruction**	**Earth ground**

After reading this specifications and instructions manual, store it where the user can access it easily for reference.

The numeric control unit is configured of the control unit, operation board, servo drive unit, spindle drive unit, power supply, servo motor and spindle motor, etc.
In this section "Precautions for safety", the following items are generically called the "motor".

- Servo motor
- Linear servo motor
- Spindle motor
- Direct-drive motor

In this section "Precautions for safety", the following items are generically called the "unit".

- Servo drive unit
- Spindle drive unit
- Power supply unit
- Scale interface unit
- Magnetic pole detection unit

POINT

Important matters that should be understood for operation of this machine are indicated as a POINT in this manual.

⚠ WARNING

1. Electric shock prevention

- **Do not open the front cover while the power is ON or during operation. Failure to observe this could lead to electric shocks.**
- **Do not operate the unit with the front cover removed. The high voltage terminals and charged sections will be exposed, and can cause electric shocks.**
- **Do not remove the front cover and connector even when the power is OFF unless carrying out wiring work or periodic inspections. The inside of the units is charged, and can cause electric shocks.**
- **Since the high voltage is supplied to the main circuit connector while the power is ON or during operation, do not touch the main circuit connector with an adjustment screwdriver or the pen tip. Failure to observe this could lead to electric shocks.**
- **Wait at least 15 minutes after turning the power OFF, confirm that the CHARGE lamp has gone out, and check the voltage between P and N terminals with a tester, etc., before starting wiring, maintenance or inspections. Failure to observe this could lead to electric shocks.**
- **Ground the unit and motor. For the motor, ground it via the drive unit.**
- **Wiring, maintenance and inspection work must be done by a qualified technician.**
- **Wire the servo drive unit and servo motor after installation. Failure to observe this could lead to electric shocks.**
- **Do not touch the switches with wet hands. Failure to observe this could lead to electric shocks.**
- **Do not damage, apply forcible stress, place heavy items on the cables or get them caught. Failure to observe this could lead to electric shocks.**
- **After assembling the built-in IPM spindle motor, if the rotor is rotated by hand etc., voltage occurs between the terminals of lead. Take care not to get electric shocks.**

⚠ WARNING

2. Injury prevention

⚠ **When handling a motor, perform operations in safe clothing.**

⚠ **In the system where the optical communication with CNC is executed, do not see directly the light generated from CN1A/CN1B connector of drive unit or the end of cable. When the light gets into eye, you may feel something is wrong for eye.**
(The light source of optical communication corresponds to class1 defined in JISC6802 or IEC60825-1.)

⚠ **The linear servo motor, direct-drive motor and built-in IPM spindle motor uses permanent magnets in the rotor, so observe the following precautions.**

(1)Handling

- The linear servo motor, direct-drive motor and built-in IPM spindle motor could adversely affect medical electronics such as pacemakers, etc., therefore, do not approach the rotor.
- Do not place magnetic materials as iron.
- When a magnetic material as iron is placed, take safety measure not to pinch fingers or hands due to the magnetic attraction force.
- Remove metal items such as watch, piercing jewelry, necklace, etc.
- Do not place portable items that could malfunction or fail due to the influence of the magnetic force.
- When the rotor is not securely fixed to the machine or device, do not leave it unattended but store it in the package properly.

(2)Transportation and storage

- Correctly store the rotor in the package to transport and store.
- During transportation and storage, draw people's attention by applying a notice saying "Strong magnet-Handle with care" to the package or storage shelf.
- Do not use a damaged package.

(3)Installation

- Take special care not to pinch fingers, etc., when installing (and unpacking) the linear servo motor.

⚠ CAUTION

1. Fire prevention

- **Install the units, motors and regenerative resistor on non-combustible material. Direct installation on combustible material or near combustible materials could lead to fires.**
- **Always install a circuit protector and contactor on the servo drive unit power input as explained in this manual. Refer to this manual and select the correct circuit protector and contactor. An incorrect selection could result in fire.**
- **Shut off the power on the unit side if a fault occurs in the units. Fires could be caused if a large current continues to flow.**
- **When using a regenerative resistor, provide a sequence that shuts off the power with the regenerative resistor's error signal. The regenerative resistor could abnormally overheat and cause a fire due to a fault in the regenerative transistor, etc.**
- **The battery unit could heat up, ignite or rupture if submerged in water, or if the poles are incorrectly wired.**
- **Cut off the main circuit power with the contactor when an alarm or emergency stop occurs.**

2. Injury prevention

- **Do not apply a voltage other than that specified in this manual, on each terminal. Failure to observe this item could lead to ruptures or damage, etc.**
- **Do not mistake the terminal connections. Failure to observe this item could lead to ruptures or damage, etc.**
- **Do not mistake the polarity (+,-). Failure to observe this item could lead to ruptures or damage, etc.**
- **Do not touch the radiation fin on unit back face, regenerative resistor or motor, etc., or place parts (cables, etc.) while the power is turned ON or immediately after turning the power OFF. These parts may reach high temperatures, and can cause burns or part damage.**
- **Structure the cooling fan on the unit back face, etc., etc so that it cannot be touched after installation. Touching the cooling fan during operation could lead to injuries.**
- **Take care not to suck hair, clothes, etc. into the cooling fan.**

⚠ CAUTION

3. Various precautions

Observe the following precautions. Incorrect handling of the unit could lead to faults, injuries and electric shocks, etc.

(1) Transportation and installation

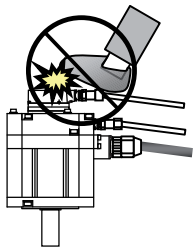
⚠ **Correctly transport the product according to its weight.**

❗ **Use the motor's hanging bolts only when transporting the motor. Do not transport the machine when the motor is installed on the machine.**

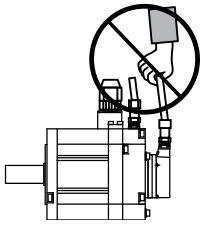
⚠ **Do not stack the products above the tolerable number.**

⚠ **Follow this manual and install the unit or motor in a place where the weight can be borne.**

⚠ **Do not get on top of or place heavy objects on the unit.**



⚠ **Do not hold the cables, axis or detector when transporting the motor.**



⚠ **Do not hold the connected wires or cables when transporting the units.**

⚠ **Do not hold the front cover when transporting the unit. The unit could drop.**

⚠ **Always observe the installation directions of the units or motors.**

⚠ **Secure the specified distance between the units and control panel, or between the servo drive unit and other devices.**

⚠ **Do not install or run a unit or motor that is damaged or missing parts.**

⚠ **Do not block the intake or exhaust ports of the motor provided with a cooling fan.**

⚠ **Do not let foreign objects enter the units or motors. In particular, if conductive objects such as screws or metal chips, etc., or combustible materials such as oil enter, rupture or breakage could occur.**

⚠ **Provide adequate protection using a material such as connector for conduit to prevent screws, metallic detritus, water and other conductive matter or oil and other combustible matter from entering the motor through the power line lead-out port.**

⚠ **The units, motors and detectors are precision devices, so do not drop them or apply strong impacts to them.**

⚠ CAUTION

⚠ **Store and use the units under the following environment conditions.**

Environment	Unit	Motor
Ambient temperature	Operation: 0 to 55° C (with no freezing), Storage / Transportation: -15° C to 70° C (with no freezing)	Operation: 0 to 40° C (with no freezing), Storage: -15° C to 70° C (Note2) (with no freezing)
Ambient humidity	Operation: 90%RH or less (with no dew condensation) Storage / Transportation: 90%RH or less (with no dew condensation)	Operation: 80%RH or less (with no dew condensation), Storage: 90%RH or less (with no dew condensation)
Atmosphere	Indoors (no direct sunlight) With no corrosive gas, inflammable gas, oil mist, dust or conductive fine particles	
Altitude	Operation/Storage: 1000 meters or less above sea level, Transportation: 13000 meters or less above sea level	Operation: 1000 meters or less above sea level, Storage: 10000 meters or less above sea level
Vibration/impact	According to each unit or motor specification	

(Note 1) For details, confirm each unit or motor specifications in addition.
(Note 2) -15°C to 55°C for linear servo motor.

⚠ **When disinfectants or insecticides must be used to treat wood packaging materials, always use methods other than fumigation (for example, apply heat treatment at the minimum wood core temperature of 56 °C for a minimum duration of 30 minutes (ISPM No. 15 (2009))).**
If products such as units are directly fumigated or packed with fumigated wooden materials, halogen substances (including fluorine, chlorine, bromine and iodine) contained in fumes may contribute to the erosion of the capacitors.
When exporting the products, make sure to comply with the laws and regulations of each country.

⚠ **Do not use the products in conjunction with any components that contain halogenated flame retardants (bromine, etc). Failure to observe this may cause the erosion of the capacitors.**

⚠ **Securely fix the servo motor to the machine. Insufficient fixing could lead to the servo motor slipping off during operation.**

⚠ **Always install the servo motor with reduction gear in the designated direction. Failure to do so could lead to oil leaks.**

⚠ **Structure the rotary sections of the motor so that it can never be touched during operation. Install a cover, etc., on the shaft.**

⚠ **When installing a coupling to a servo motor shaft end, do not apply an impact by hammering, etc. The detector could be damaged.**

⚠ **Do not apply a load exceeding the tolerable load onto the servo motor shaft. The shaft could break.**

⚠ **Store the motor in the package box.**

⚠ **When inserting the shaft into the built-in IPM spindle motor, do not heat the rotor higher than 130°C. The magnet could be demagnetized, and the specifications characteristics will not be ensured.**

⚠ **Always use a nonmagnetic tool (explosion-proof beryllium copper alloy safety tool: NGK Insulators, etc.) when installing the built-in IPM spindle motor, direct-drive motor and linear servo motor.**

⚠ **Always provide a mechanical stopper on the end of the linear servo motor's travel path.**

❗ **If the unit has been stored for a long time, always check the operation before starting actual operation. Please contact the Service Center, Service Station, Sales Office or delayer.**

⚠ CAUTION

(2) Wiring

⚠ **Correctly and securely perform the wiring. Failure to do so could lead to abnormal operation of the motor.**

⚠ **Do not install a condensing capacitor, surge absorber or radio noise filter on the output side of the drive unit.**

⚠ **Correctly connect the output side of the drive unit (terminals U, V, W). Failure to do so could lead to abnormal operation of the motor.**

⚠ **When using a power regenerative power supply unit, always install an AC reactor for each power supply unit.**

⚠ **In the main circuit power supply side of the unit, always install an appropriate circuit protector or contactor for each unit. Circuit protector or contactor cannot be shared by several units.**

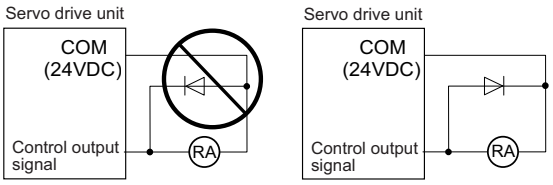
⚠ **Always connect the motor to the drive unit's output terminals (U, V, W).**

⚠ **Do not directly connect a commercial power supply to the servo motor. Failure to observe this could result in a fault.**

⚠ **When using an inductive load such as a relay, always connect a diode as a noise measure parallel to the load.**

⚠ **When using a capacitance load such as a lamp, always connect a protective resistor as a noise measure serial to the load.**

⚠ **Do not reverse the direction of a diode which connect to a DC relay for the control output signals such as contractor and motor brake output, etc. to suppress a surge. Connecting it backwards could cause the drive unit to malfunction so that signals are not output, and emergency stop and other safety circuits are inoperable.**



⚠ **Do not connect/disconnect the cables connected between the units while the power is ON.**

⚠ **Securely tighten the cable connector fixing screw or fixing mechanism. An insecure fixing could cause the cable to fall off while the power is ON.**

⚠ **When using a shielded cable instructed in the instruction manual, always ground the cable with a cable clamp, etc.**

⚠ **Always separate the signals wires from the drive wire and power line.**

⚠ **Use wires and cables that have a wire diameter, heat resistance and flexibility that conforms to the system.**

(3) Trial operation and adjustment

⚠ **Check and adjust each program and parameter before starting operation. Failure to do so could lead to unforeseen operation of the machine.**

⚠ **Do not make remarkable adjustments and changes of parameter as the operation could become unstable.**

⚠ **The usable motor and unit combination is predetermined. Always check the combinations and parameters before starting trial operation.**

⚠ **The direct-drive motor and linear servo motor do not have a stopping device such as magnetic brakes. Install a stopping device on the machine side.**

⚠ CAUTION

(4) Usage methods

In abnormal state, install an external emergency stop circuit so that the operation can be stopped and power shut off immediately.

Turn the power OFF immediately if smoke, abnormal noise or odors are generated from the unit or motor.

Do not disassemble or repair this product.

Never make modifications.

When an alarm occurs, the machine will start suddenly if an alarm reset (RST) is carried out while an operation start signal (ST) is being input. Always confirm that the operation signal is OFF before carrying out an alarm reset. Failure to do so could lead to accidents or injuries.

Reduce magnetic damage by installing a noise filter. The electronic devices used near the unit could be affected by magnetic noise. Install a line noise filter, etc., if there is a risk of magnetic noise.

Use the unit, motor and regenerative resistor with the designated combination. Failure to do so could lead to fires or trouble.

The brake (magnetic brake) of the servo motor are for holding, and must not be used for normal braking.

There may be cases when holding is not possible due to the magnetic brake's life, the machine construction (when ball screw and servo motor are coupled via a timing belt, etc.) or the magnetic brake's failure. Install a stop device to ensure safety on the machine side.

After changing the programs/parameters or after maintenance and inspection, always test the operation before starting actual operation.

Do not enter the movable range of the machine during automatic operation. Never place body parts near or touch the spindle during rotation.

Follow the power supply specification conditions given in each specification for the power (input voltage, input frequency, tolerable sudden power failure time, etc.).

Set all bits to "0" if they are indicated as not used or empty in the explanation on the bits.

Do not use the dynamic brakes except during the emergency stop. Continued use of the dynamic brakes could result in brake damage.

If a circuit protector for the main circuit power supply is shared by several units, the circuit protector may not activate when a short-circuit fault occurs in a small capacity unit. This is dangerous, so never share the circuit protector.

Mitsubishi spindle motor is dedicated to machine tools. Do not use for other purposes.

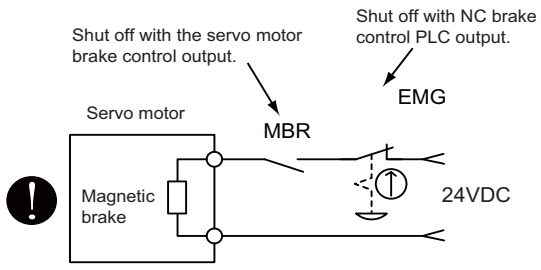
(5) Troubleshooting

If a hazardous situation is predicted during power failure or product trouble, use a servo motor with magnetic brakes or install an external brake mechanism.

Use a double circuit configuration that allows the operation circuit for the magnetic brakes to be operated even by the external emergency stop signal.

Always turn the main circuit power of the motor OFF when an alarm occurs.

If an alarm occurs, remove the cause, and secure the safety before resetting the alarm.



⚠ CAUTION

(6) Maintenance, inspection and part replacement

⚠ **Always backup the programs and parameters before starting maintenance or inspections.**

⚠ **The capacity of the electrolytic capacitor will drop over time due to self-discharging, etc. To prevent secondary disasters due to failures, replacing this part every five years when used under a normal environment is recommended. Contact the Service Center, Service Station, Sales Office or delayer for repairs or part replacement.**

⚠ **Do not perform a megger test (insulation resistance measurement) during inspections.**

❗ **If the battery low warning is issued, back up the machining programs, tool data and parameters with an input/output unit, and then replace the battery.**

⚠ **Do not short circuit, charge, overheat, incinerate or disassemble the battery.**

⚠ **For after-purchase servicing of the built-in motor, only the servicing parts for MITSUBISHI detector can be supplied. For the motor body, prepare the spare parts at the machine manufacturers.**

⚠ **For maintenance, part replacement, and services in case of failures in the built-in motor (including the detector), take necessary actions at the machine manufacturers. For drive unit, Mitsubishi can offer the after-purchase servicing as with the general drive unit.**

(7) Disposal

⚠ **Take the batteries and backlights for LCD, etc., off from the controller, drive unit and motor, and dispose of them as general industrial wastes.**

⚠ **Do not disassemble the unit or motor.**

⚠ **Dispose of the battery according to local laws.**

⚠ **Always return the secondary side (magnet side) of the linear servo motor to the Service Center or Service Station.**

⚠ **When incinerating optical communication cable, hydrogen fluoride gas or hydrogen chloride gas which is corrosive and harmful may be generated. For disposal of optical communication cable, request for specialized industrial waste disposal services that has incineration facility for disposing hydrogen fluoride gas or hydrogen chloride gas.**

(8) Transportation

⚠ **The unit and motor are precision parts and must be handled carefully.**

⚠ **According to a United Nations Advisory, the battery unit and battery must be transported according to the rules set forth by the International Civil Aviation Organization (ICAO), International Air Transportation Association (IATA), International Maritime Organization (IMO), and United States Department of Transportation (DOT), etc.**

(9) General precautions

The drawings given in this manual show the covers and safety partitions, etc., removed to provide a clearer explanation. Always return the covers or partitions to their respective places before starting operation, and always follow the instructions given in this manual.

Treatment of waste

The following two laws will apply when disposing of this product. Considerations must be made to each law. The following laws are in effect in Japan. Thus, when using this product overseas, the local laws will have a priority. If necessary, indicate or notify these laws to the final user of the product.

(1) Requirements for "Law for Promotion of Effective Utilization of Resources"
   (a) Recycle as much of this product as possible when finished with use.
   (b) When recycling, often parts are sorted into steel scraps and electric parts, etc., and sold to scrap contractors. Mitsubishi recommends sorting the product and selling the members to appropriate contractors.

(2) Requirements for "Law for Treatment of Waste and Cleaning"
   (a) Mitsubishi recommends recycling and selling the product when no longer needed according to item (1) above. The user should make an effort to reduce waste in this manner.
   (b) When disposing a product that cannot be resold, it shall be treated as a waste product.
   (c) The treatment of industrial waste must be commissioned to a licensed industrial waste treatment contractor, and appropriate measures, including a manifest control, must be taken.
   (d) Batteries correspond to "primary batteries", and must be disposed of according to local disposal laws.

Disposal

(Note) This symbol mark is for EU countries only.
This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II.

Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and/or reused.
This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.
If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows:
Hg: mercury (0,0005%), Cd: cadmium (0,002%), Pb: lead (0,004%)
In the European Union there are separate collection systems for used batteries and accumulators.
Please, dispose of batteries and accumulators correctly at your local community waste collection/ recycling centre.

Please, help us to conserve the environment we live in!

Trademarks

MELDAS, MELSEC, EZSocket, EZMotion, iQ Platform, MELSOFT, GOT, CC-Link, CC-Link/LT and CC-Link IE are either trademarks or registered trademarks of Mitsubishi Electric Corporation in Japan and/or other countries.

Other company and product names that appear in this manual are trademarks or registered trademarks of the respective companies.

本製品の取扱いについて

(日本語 /Japanese)
本製品は工業用 (クラス A) 電磁環境適合機器です。販売者あるいは使用者はこの点に注意し、住商業環境以外での使用をお願いいたします。

Handling of our product

(English)
This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

본 제품의 취급에 대해서

(한국어 /Korean)
이 기기는 업무용 (A 급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며 가정외의 지역에서 사용하는 것을 목적으로 합니다 .

WARRANTY

Please confirm the following product warranty details before using MITSUBISHI CNC.

1. Warranty Period and Coverage

Should any fault or defect (hereafter called “failure”) for which we are liable occur in this product during the warranty period, we shall provide repair services at no cost through the distributor from which the product was purchased or through a Mitsubishi Electric service provider. Note, however that this shall not apply if the customer was informed prior to purchase of the product that the product is not covered under warranty. Also note that we are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit is replaced.

[Warranty Term]
The term of warranty for this product shall be twenty-four (24) months from the date of delivery of the product to the end user, provided the product is installed in the same country it was purchased in (but in no event longer than thirty (30) months, including the distribution time, after shipment from Mitsubishi Electric or its distributor).

[Limitations]
(1) The customer is requested to conduct an initial failure diagnosis by him/herself, as a general rule. It can also be carried out by us or our service provider upon the customer’s request and the actual cost will be charged.
(2) This warranty applies only when the conditions, method, environment, etc., of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual, user’s manual, and the caution label affixed to the product, etc.
(3) Even during the term of warranty, repair costs shall be charged to the customer in the following cases:
  (a) a failure caused by improper storage or handling, carelessness or negligence, etc., or a failure caused by the customer’s hardware or software problem
  (b) a failure caused by any alteration, etc., to the product made by the customer without Mitsubishi Electric’s approval
  (c) a failure which may be regarded as avoidable, if the customer’s equipment in which this product is incorporated is equipped with a safety device required by applicable laws or has any function or structure considered to be indispensable in the light of common sense in the industry
  (d) a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
  (e) any replacement of consumable parts (including a battery, relay and fuse)
  (f) a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning, and natural disasters
  (g) a failure which is unforeseeable under technologies available at the time of shipment of this product from our company
  (h) any other failures which we are not responsible for or which the customer acknowledges we are not responsible for

2. Service in Overseas Countries

If the customer installs the product purchased from us in his/her machine or equipment, and export it to any country other than where he/she bought it, the customer may sign a paid warranty contract with our local FA center.
For details please contact the distributor from which the customer purchased the product.

3. Exclusion of Responsibility for Compensation against Loss of Opportunity, Secondary Loss, etc.

Whether during or after the term of warranty, we assume no responsibility for any damages arising from causes for which we are not responsible, any losses of opportunity and/or profit incurred by the customer due to a failure of this product, any damages, secondary damages or compensation for accidents arising under specific circumstances that either foreseen or unforeseen by Mitsubishi Electric, any damages to products other than this product, or compensation for any replacement work, readjustment and startup test run of on-site machines or any other operations conducted by the customer.

4. Changes in Product Specifications

Specifications shown in our catalogs, manuals or technical documents are subject to change without notice.

5. Product Application

(1) For the use of this product, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in the product, and a backup or fail-safe function should operate on an external system to the product when any failure or malfunction occurs.
(2) Mitsubishi CNC is designed and manufactured solely for applications to machine tools to be used for industrial purposes. Do not use this product in any applications other than those specified above, especially those which are substantially influential on the public interest or which are expected to have significant influence on human lives or properties.

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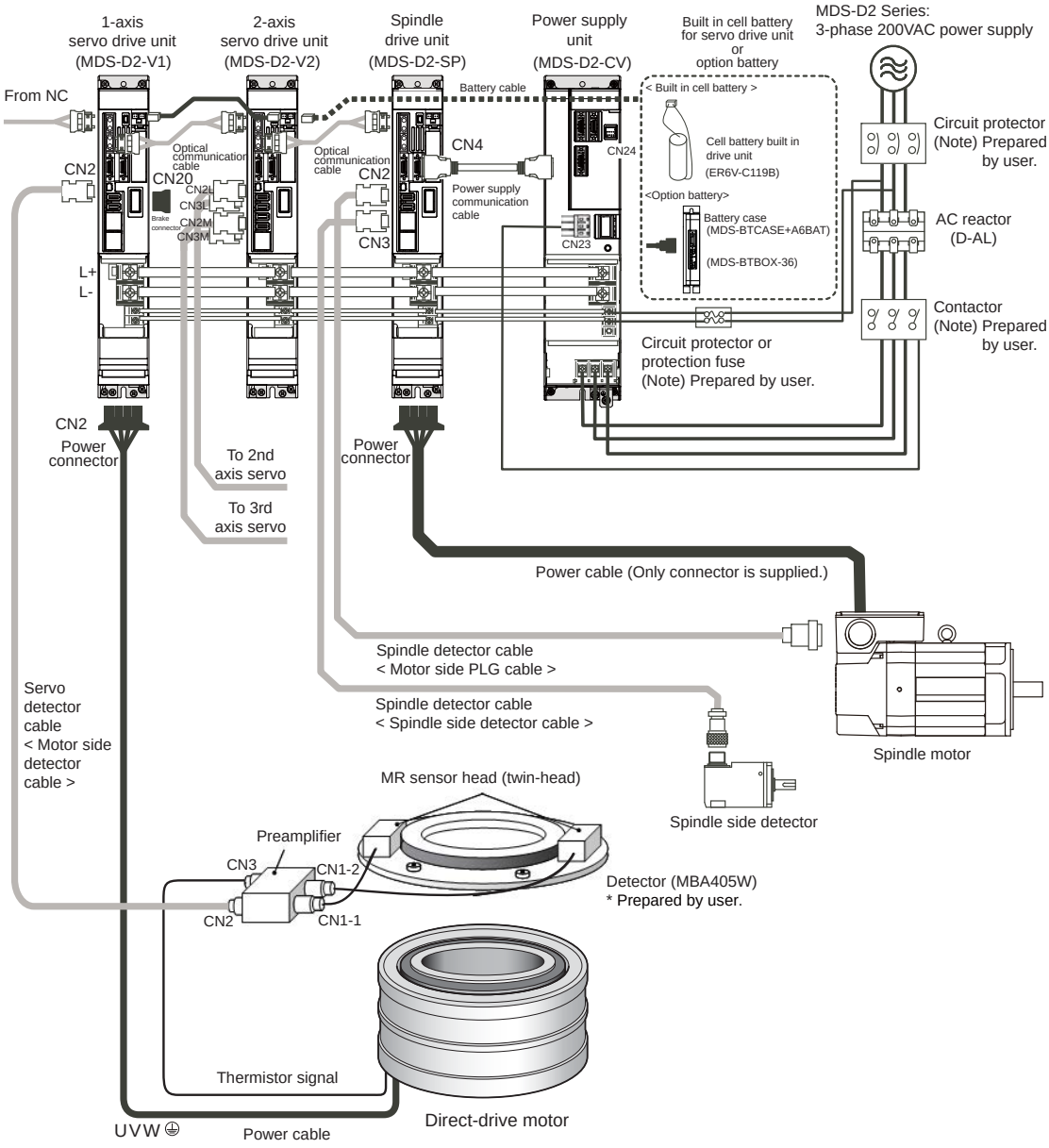
1

Introduction

1-1 Servo drive system configuration

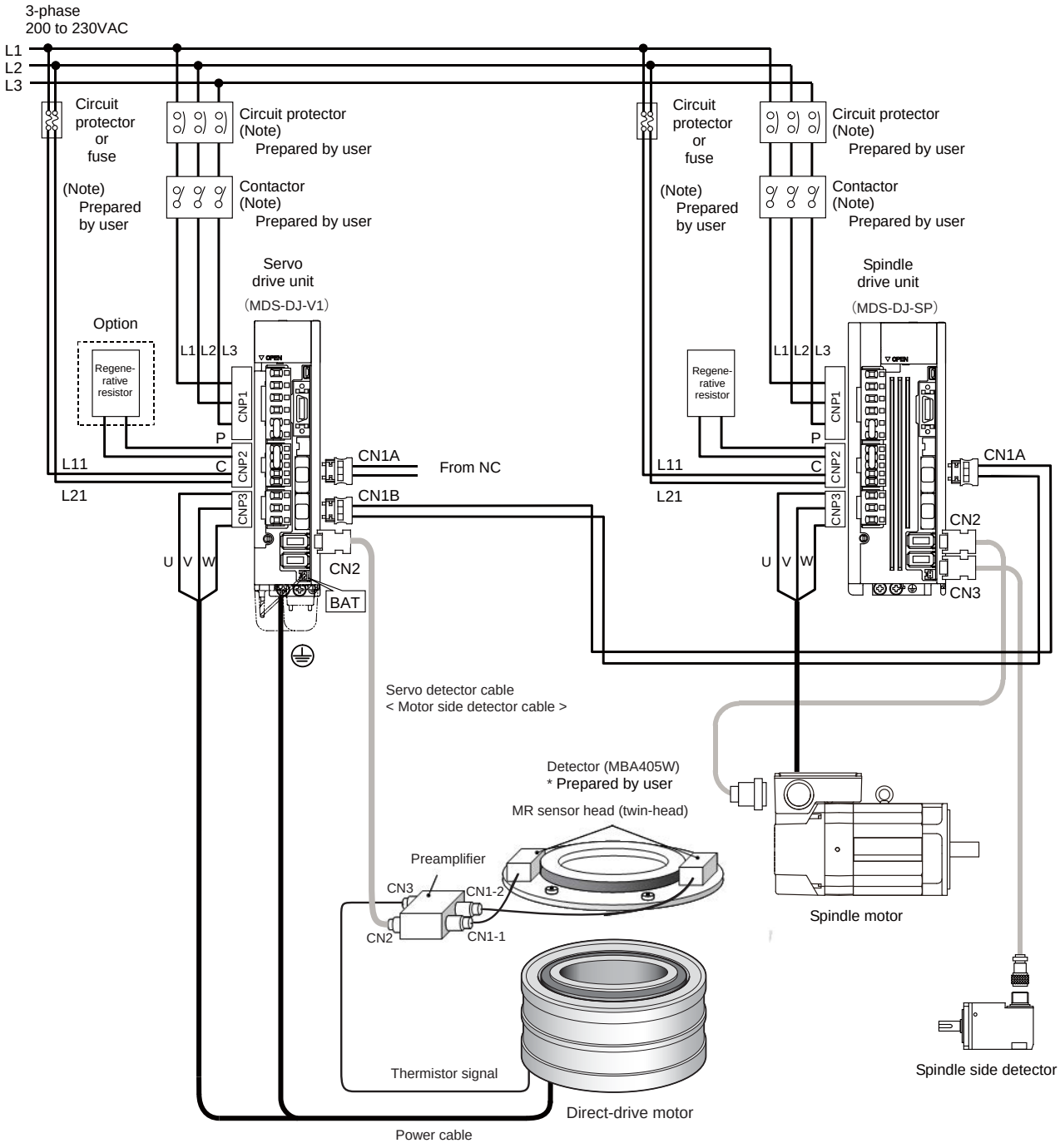
1-1-1 System configuration

< MDS-D2 Series >



⚠CAUTION **Keep the detection sensor cable away from the power cable.**

< MDS-DJ-V1 Series >



⚠CAUTION **Keep the detection sensor cable away from the power cable.**

1-2 Explanation of type

1-2-1 Direct-drive motor type

(1) TM-RB Series

< Primary side (coil side) >

TM-RBP (1) (2) (3)

(1) Rated torque

Symbol	Rated torque
012	12 N･m
036	36 N･m
048	48 N･m
105	105 N･m
150	150 N･m
340	340 N･m
500	500 N･m

(2) Stator dimensions

Symbol	Dimension
C	DIA 130 mm
E	DIA 180 mm
G	DIA 230 mm
J	DIA 330 mm

(3) Rated rotation speed

Symbol	Rotation speed
10	100 r/min
20	200 r/min

(Note 1) This explains the model name system of direct-drive motors, but does not mean all the combinations are available.
(Note 2) The primary and secondary sides having the same variable part of the name are combined to form a direct-drive motor.

< Secondary side (magnet side) >

TM-RBS (1) (2) (3)

(1) Rated torque

Symbol	Rated torque
012	12 N･m
036	36 N･m
048	48 N･m
105	105 N･m
150	150 N･m
340	340 N･m
500	500 N･m

(2) Stator dimensions

Symbol	Dimension
C	DIA 130 mm
E	DIA 180 mm
G	DIA 230 mm
J	DIA 330 mm

(3) Rated rotation speed

Symbol	Rotation speed
10	100 r/min
20	200 r/min

(Note 1) This explains the model name system of direct-drive motors, but does not mean all the combinations are available.
(Note 2) The primary and secondary sides having the same variable part of the name are combined to form a direct-drive motor.

2

Specifications

2-1 Direct-drive motor

2-1-1 Environmental conditions

Environment	Conditions
Ambient temperature	0˚C to +40˚C (with no freezing)
Ambient humidity	80% RH or less (with no dew condensation)
Storage temperature	-15˚C to +70˚C(with no freezing)
Storage humidity	90% RH or less (with no dew condensation)
Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas or dust No oil or water splash
Vibration	5G or less (2.5G or less for TM-RBP340J20, TM-RBP500J20)
Altitude	1000m or less above sea level

2-1-2 Precautions for storage

⚠ WARNING

1. **Correctly store the direct-drive motor in the package to transport and store.**
   -> As the secondary side has permanent magnets in it, and the magnetic attraction force is generated between magnetic material as iron, unexpected accidents or failures may occur if the secondary side is left unattended.
2. **During transportation and storage, draw people's attention by applying a notice saying "Strong magnet-Handle with care" to the package or storage shelf.**

⚠ CAUTION

1. **Do not arrange the product, or do not give a shock.**
2. **Do not get on top of or place heavy objects on the product.**
3. **When suspending the product with lifting sling, etc, do not give a shock or stress to the mold.**
4. **If the product has been stored for a long time, please contact your local service center or service station.**

<How to suspend the product>

(1) Primary side stator

Before you suspend the primary side stator alone, attach eye bolts, etc. to the fixing screws on a surface end. Please ensure that the wires put no stress on the mold, connector or cooling vent when suspending the product. In addition, please be careful that no stress is applied to the lead wire when you use lead-out type.
When suspending the product, support it with at least 3 screws.

(2) Secondary side rotor

Before you suspend the secondary side, attach the eye bolts, etc. to the fixing screws.
In order to avoid any risks posed by the magnetic attraction force, the rotary axis must be in the vertical direction, and support it at 3 or more points to keep its posture.

<Dust and drip proof structure>

Even if the coil end of the primary side stator has mold structure, it cannot guarantee full dust and drip proof. So please make sure to construct your machine structure to be able to avoid chips, water, oil, cutting fluid, etc. from entering in the motor.

<Cooling>

Construct the liquid-cooling (oil cooling) structure around the primary side stator according to your conditions, for example, put a cooling jacket around the primary side stator.

2-1-3 Specifications list

< TM-RB Series >

Direct-drive motor type for primary side		TM-RBP 012C20	TM-RBP 036E20	TM-RBP 048G20	TM-RBP 105G10	TM-RBP 105G20	TM-RBP 150G20	TM-RBP 340J20	TM-RBP 500J20
Compatible servo drive unit type	MDS-D2-V1-	40	80	80	160	160	160	320	320W
	MDS-D2-V2-	4020 (L) 4040 (L,M) 8040 (M)	8040 (L) 8080 (L,M) 16080 (M)	8040 (L) 8080 (L,M) 16080 (M)	16080 (L) 160160 (L,M)	16080 (L) 160160 (L,M)	160160 (L,M)	-	-
	MDS-DJ-V1-	40	80	80	100	-	-	-	-
Continuous characteristics	Rated output [W]	252	754	1005	1100	2199	3141	7120	10471
	Rated current [A]	6.1	12	12	21	25	33	54	82
	Rated torque [N•m]	12	36	48	105	105	150	340	500
Power facility capacity [kVA]		1.07	2.08	2.01	3.86	5.00	7.20	14.03	20.82
Rated rotation speed [r/min]		200	200	200	100	200	200	200	200
Maximum rotation speed [r/min]		500	500	500	250	500	500	400	400
Maximum current [A]		18	36	36	52	63	83	135	210
Maximum torque [N•m]		36	108	144	260	260	375	850	1280
Power rate at continuous rated torque [kW/s]		65.4	102.0	82.2	279.1	279.1	441.1	416.1	706.6
Rotor inertia [kg•cm^2]		22	127	280	395	395	510	2778	3538
Degree of protection		IP00							
Required cooling capacity [kW]		0.5	0.7	0.4	1.6	1.3	1.9	2.7	4.1
Cooling water volume		Min: 5 l/min Max: 6 l/min at 20˚C							
Environment	Ambient temperature	Operation: 0 to 40˚C (with no freezing), Storage: -15˚C to 70˚C (with no freezing)							
	Ambient humidity	Operation: 80%RH or less (with no dew condensation), Storage: 90%RH or less (with no dew condensation)							
	Atmosphere	Indoors (no direct sunlight); no corrosive gas, inflammable gas or dust No oil or water splash							
	Altitude	1000m or less above sea level							
	Vibration	5G or less						2.5G or less	
Dimensions [mm]	Primary side outer diameter	DIA 130	DIA 180	DIA 230	DIA 230	DIA 230	DIA 230	DIA 330	DIA 330
	Secondary side inner diameter	DIA 56	DIA 100	DIA 130	DIA 130	DIA 130	DIA 130	DIA 205	DIA 205
	Height	76	91	80	105	105	130	154	191
Mass [kg]	Primary side (coil)	3.9	7.1	10	13	13	16	33	41
	Secondary side (magnet)	1.7	3.7	5	7	7	9	20	26
Heat-resistant class		155(F)							

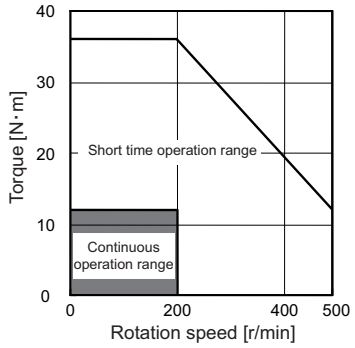
(Note 1) The above characteristics values are representative values. The maximum current and maximum torque are the values when combined with the drive unit.

(Note 2) The detector should be procured by the user.

2-1-4 Torque characteristics

< TM-RB Series >

[TM-RBP012C20]



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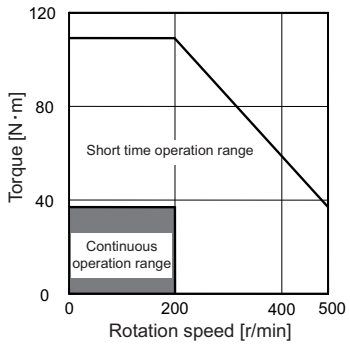
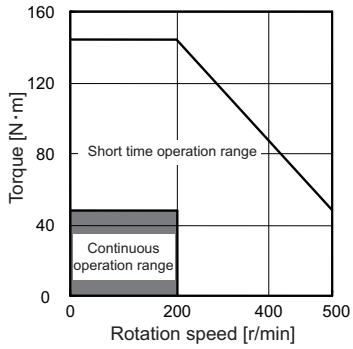


[TM-RBP048G20]



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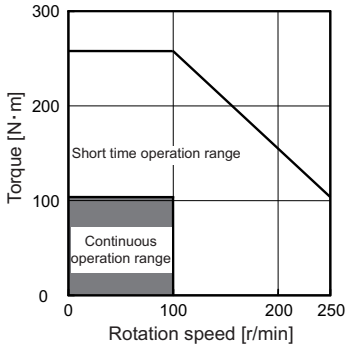

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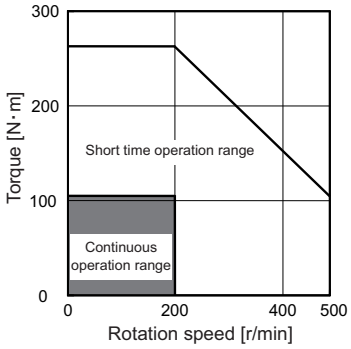

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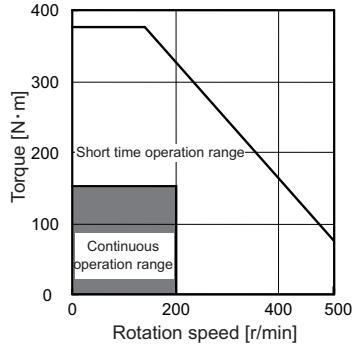

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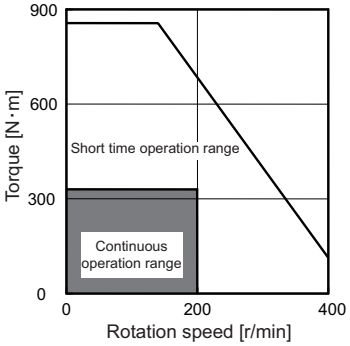

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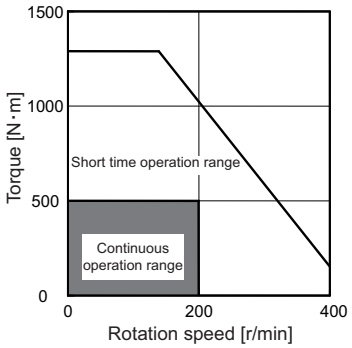


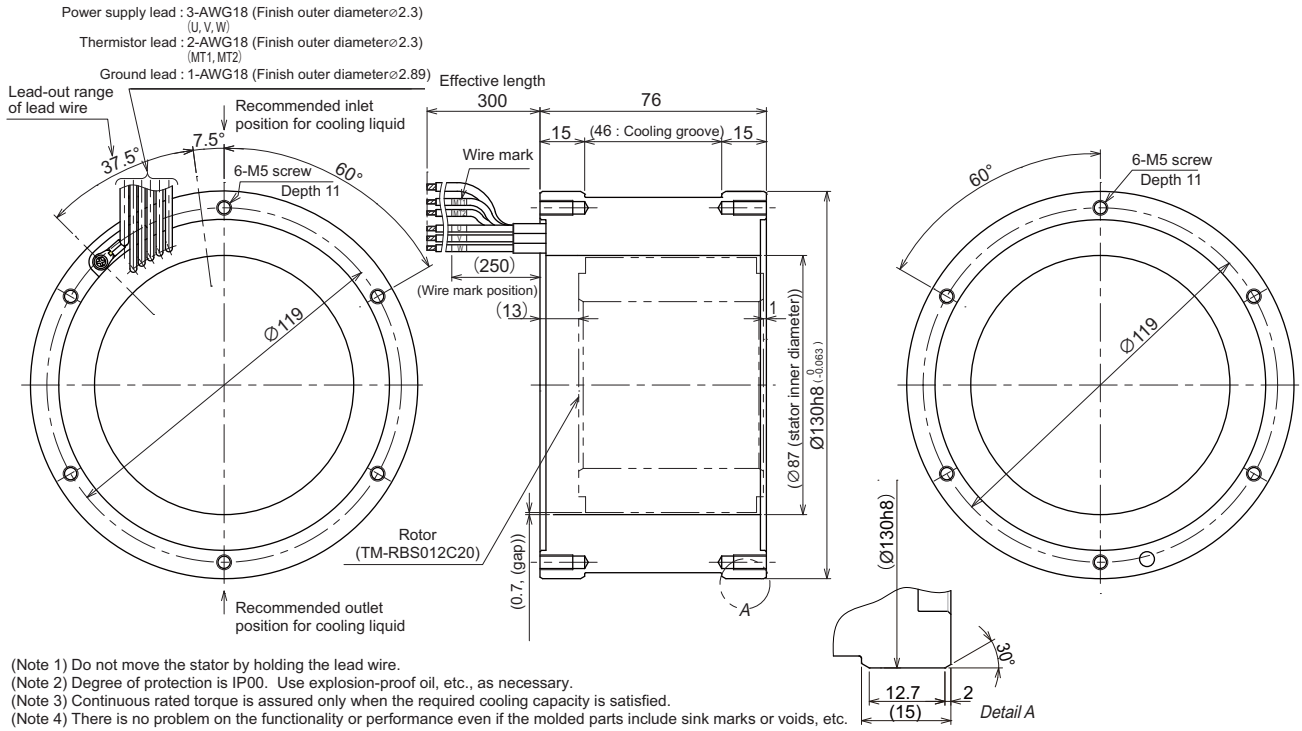
(Note) The above graphs show the data when applied the input voltage of 200VAC. When the input voltage is 200VAC or less, the short time operation range is limited.

2-1-5 Outline dimension drawings

< TM-RB Series >

[TM-RBP012C20]

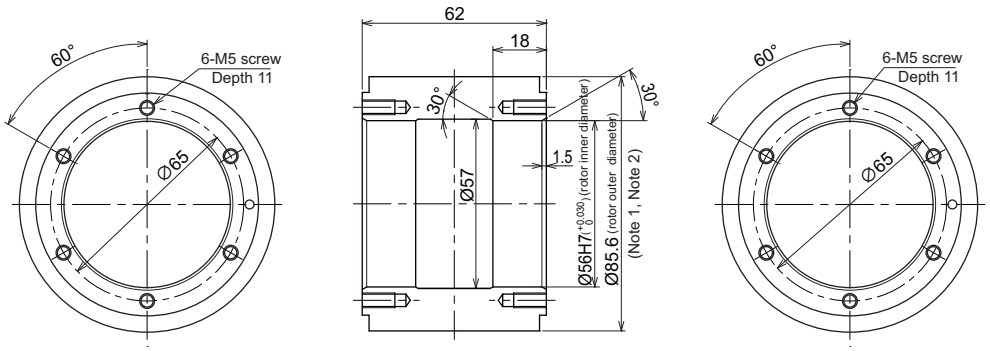
[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBS012C20]

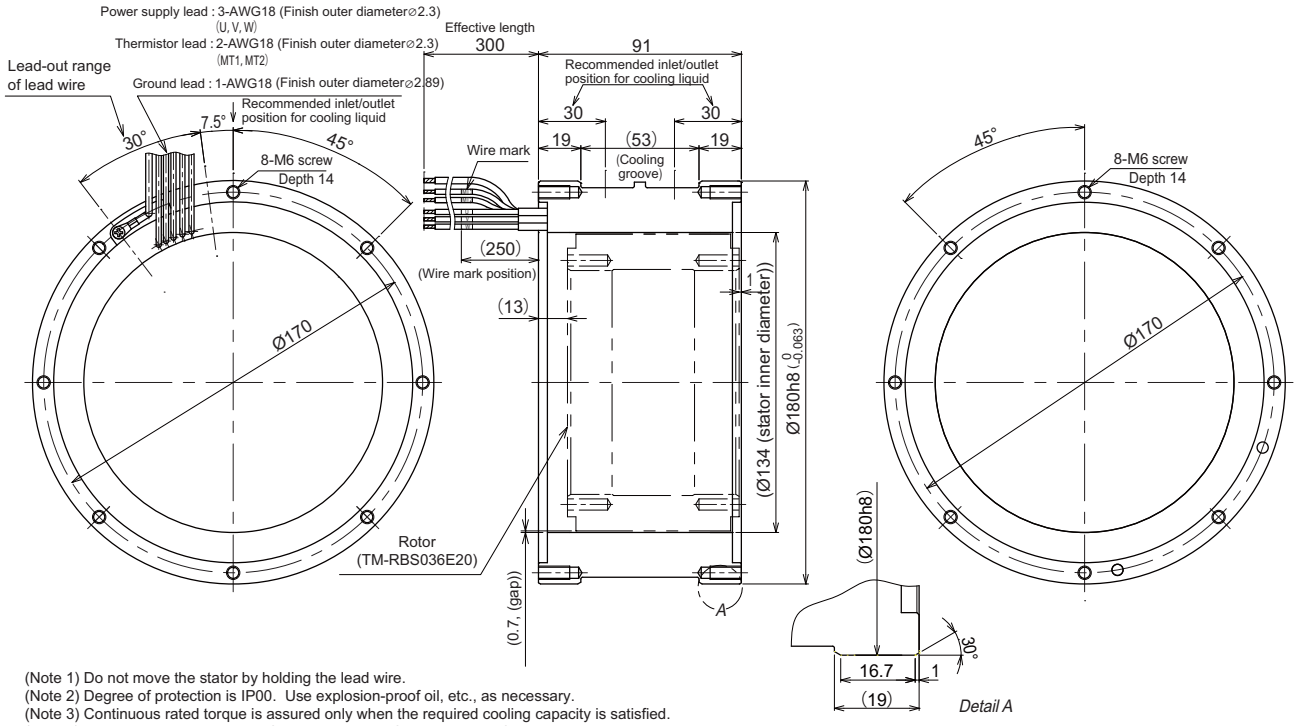
[Unit:mm]



(Note 1) Deliverable rotors are magnetized. Please note the magnetic attraction.
(Note 2) Take special care for the magnet part not to hit against a thing (A crack or chip may occur).
(Note 3) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBP036E20]

[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
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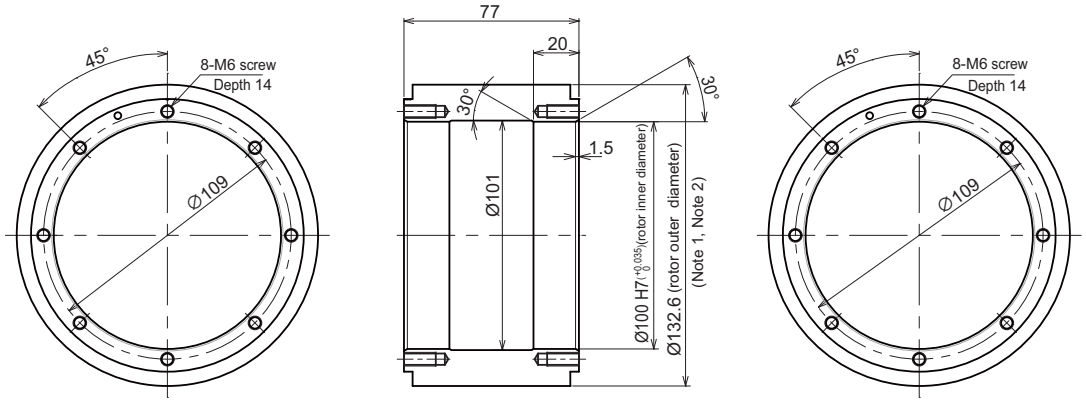
[TM-RBS036E20]

[Unit:mm]



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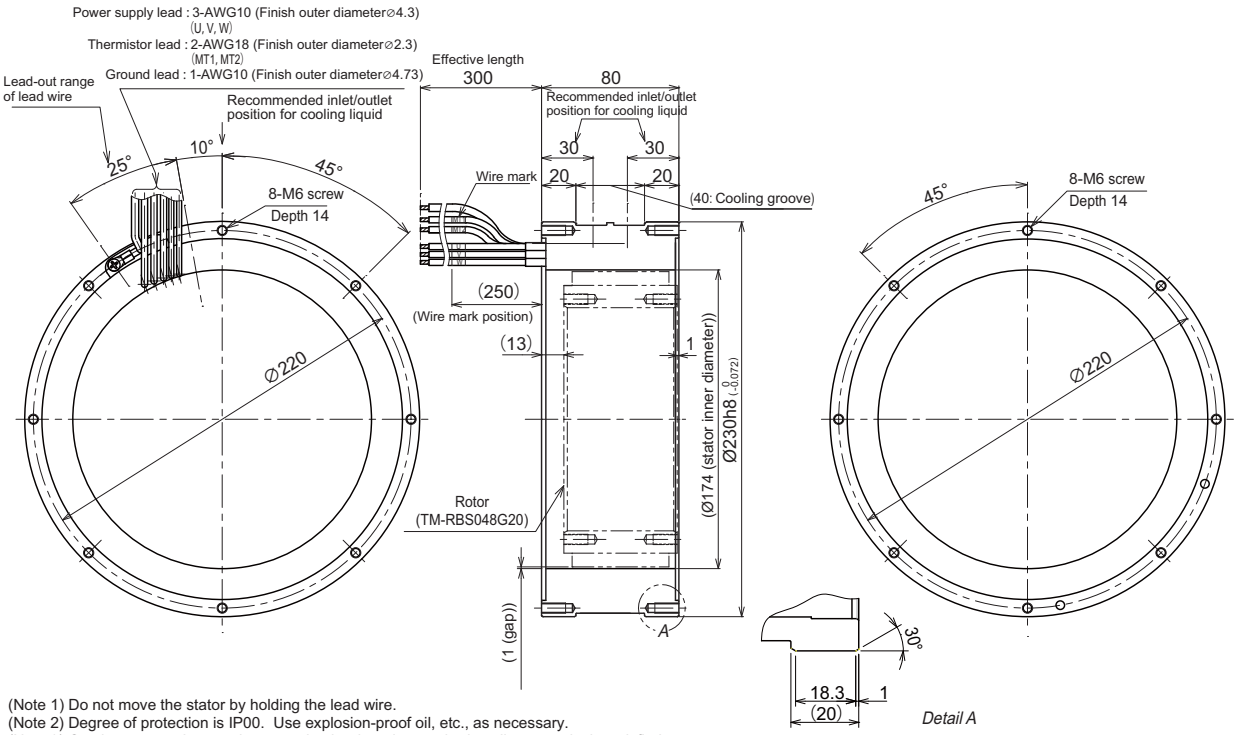
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBP048G20]

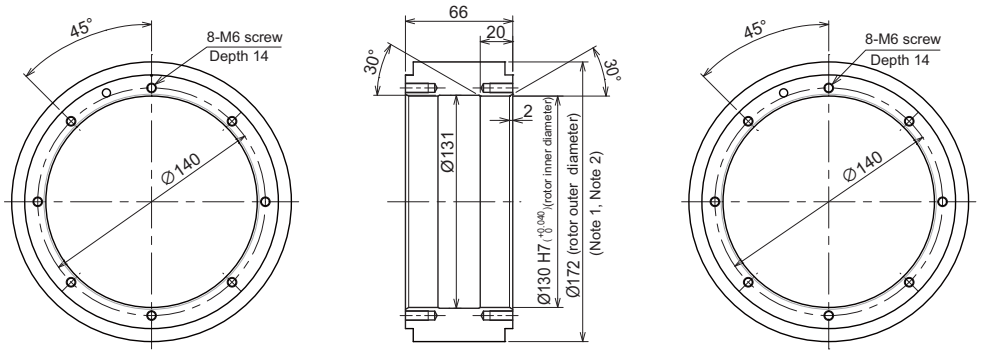
[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBS048G20]

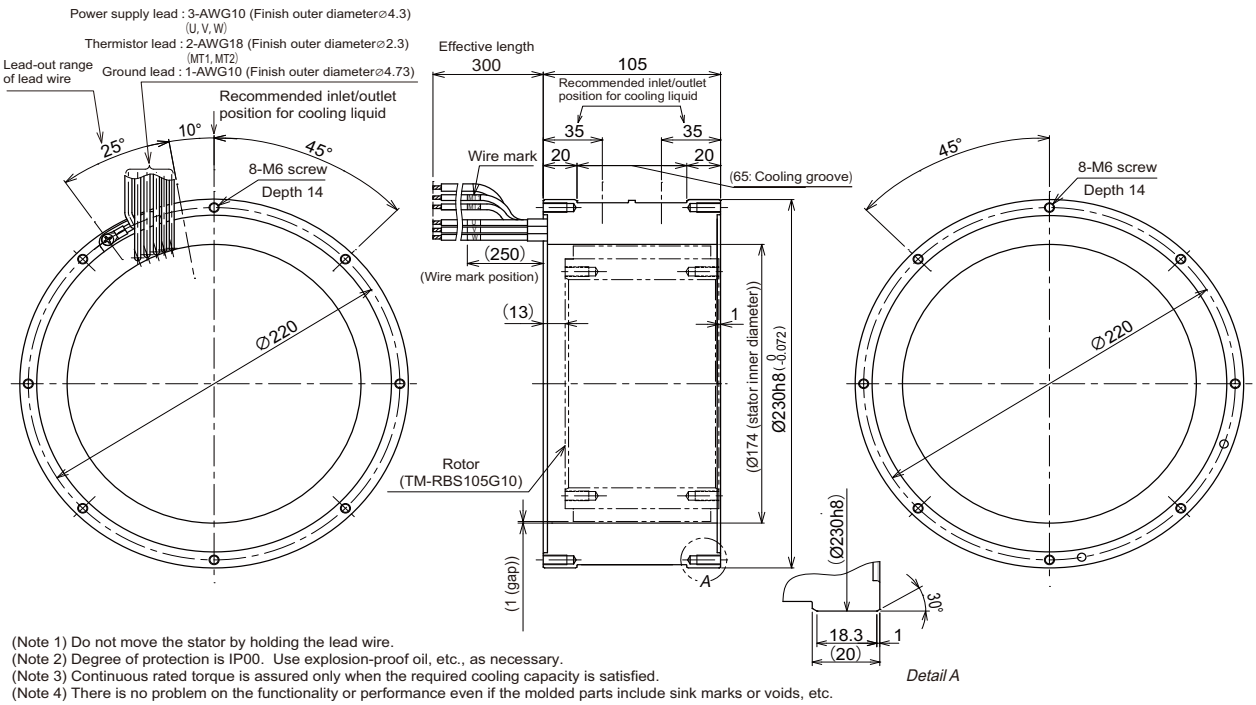
[Unit:mm]



(Note 1) Deliverable rotors are magnetized. Please note the magnetic attraction.
(Note 2) Take special care for the magnet part not to hit against a thing (A crack or chip may occur).
(Note 3) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBP105G10]

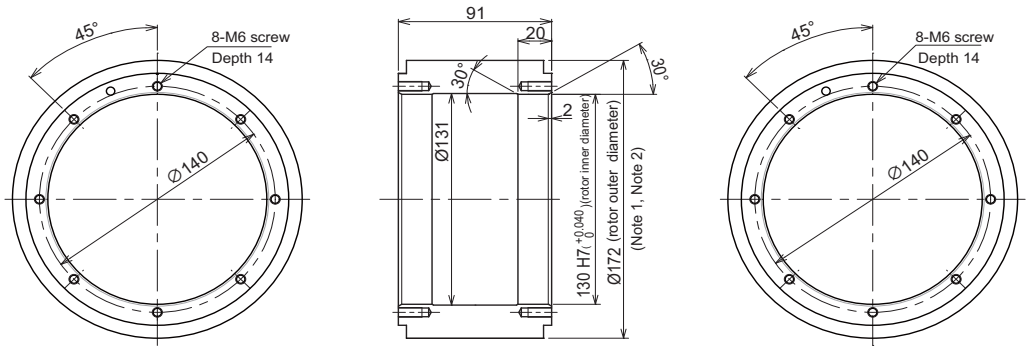
[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBS105G10]

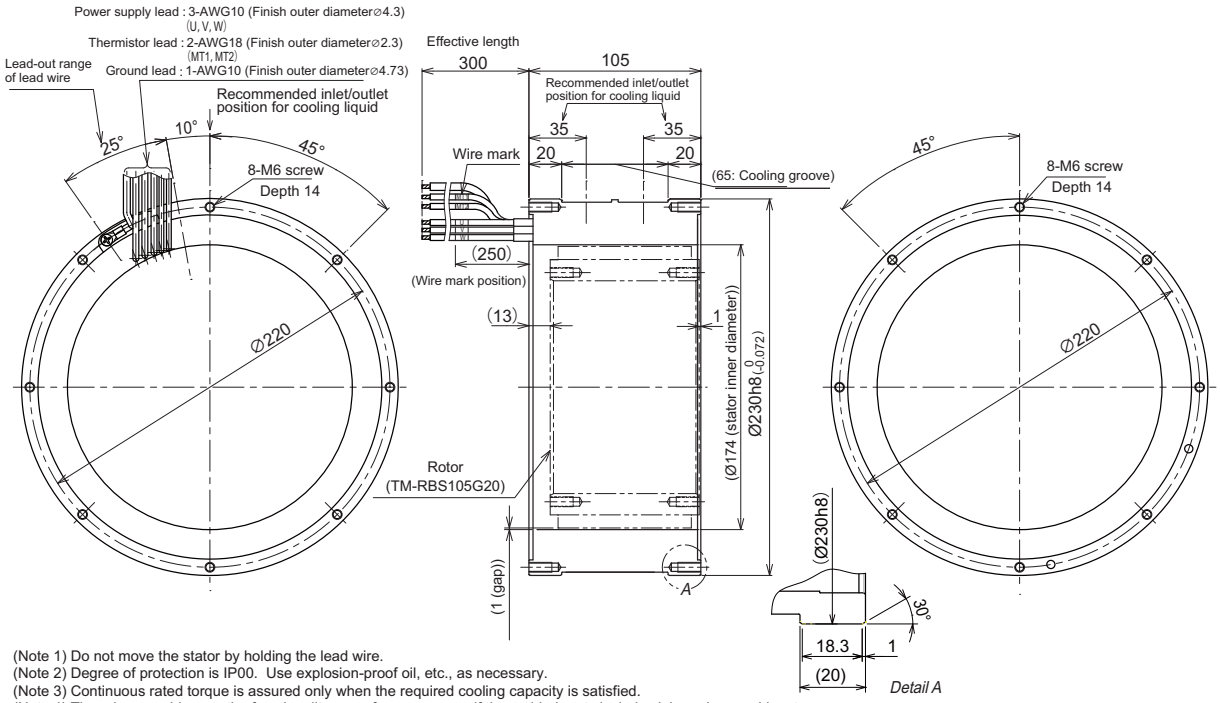
[Unit:mm]



(Note 1) Deliverable rotors are magnetized. Please note the magnetic attraction.
(Note 2) Take special care for the magnet part not to hit against a thing (A crack or chip may occur).
(Note 3) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBP105G20]

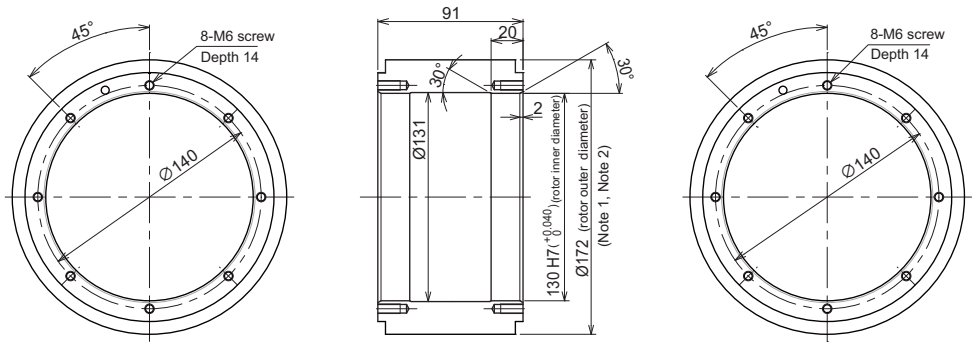
[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBS105G20]

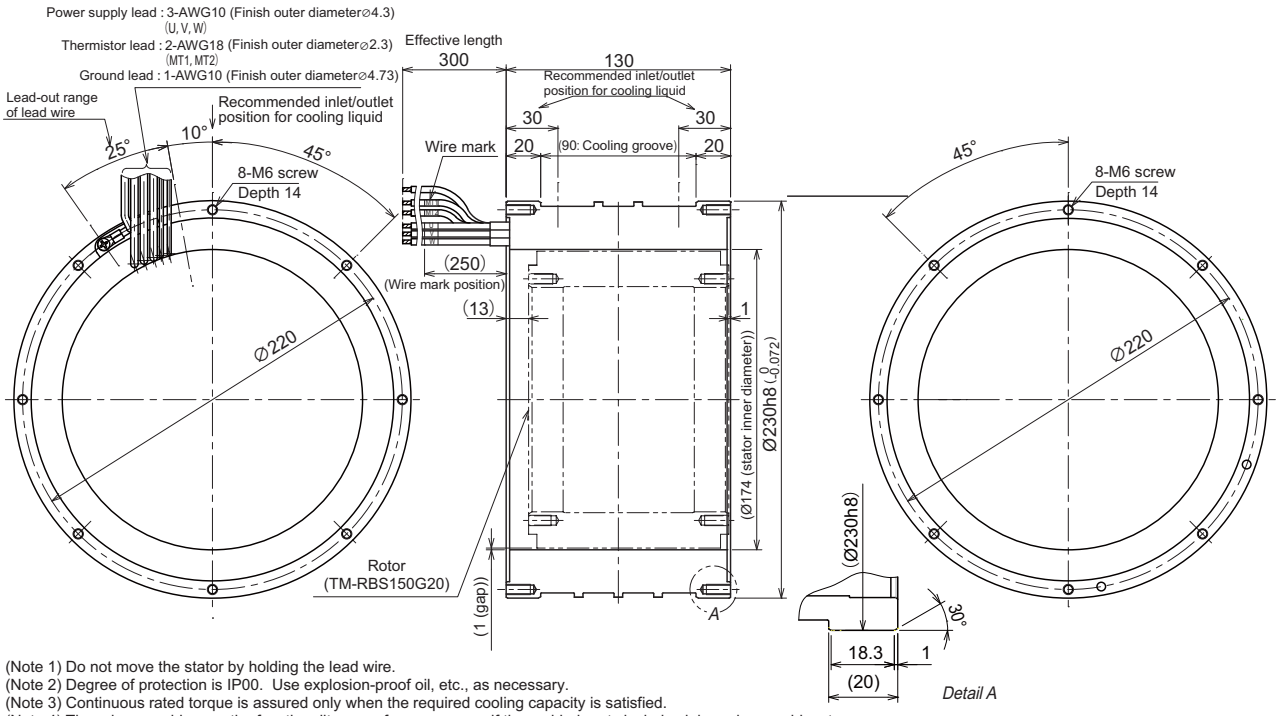
[Unit:mm]



(Note 1) Deliverable rotors are magnetized. Please note the magnetic attraction.
(Note 2) Take special care for the magnet part not to hit against a thing (A crack or chip may occur).
(Note 3) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBP150G20]

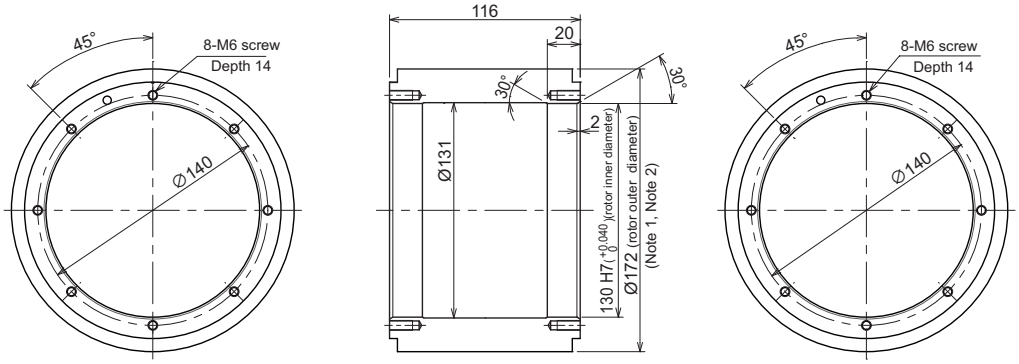
[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBS150G20]

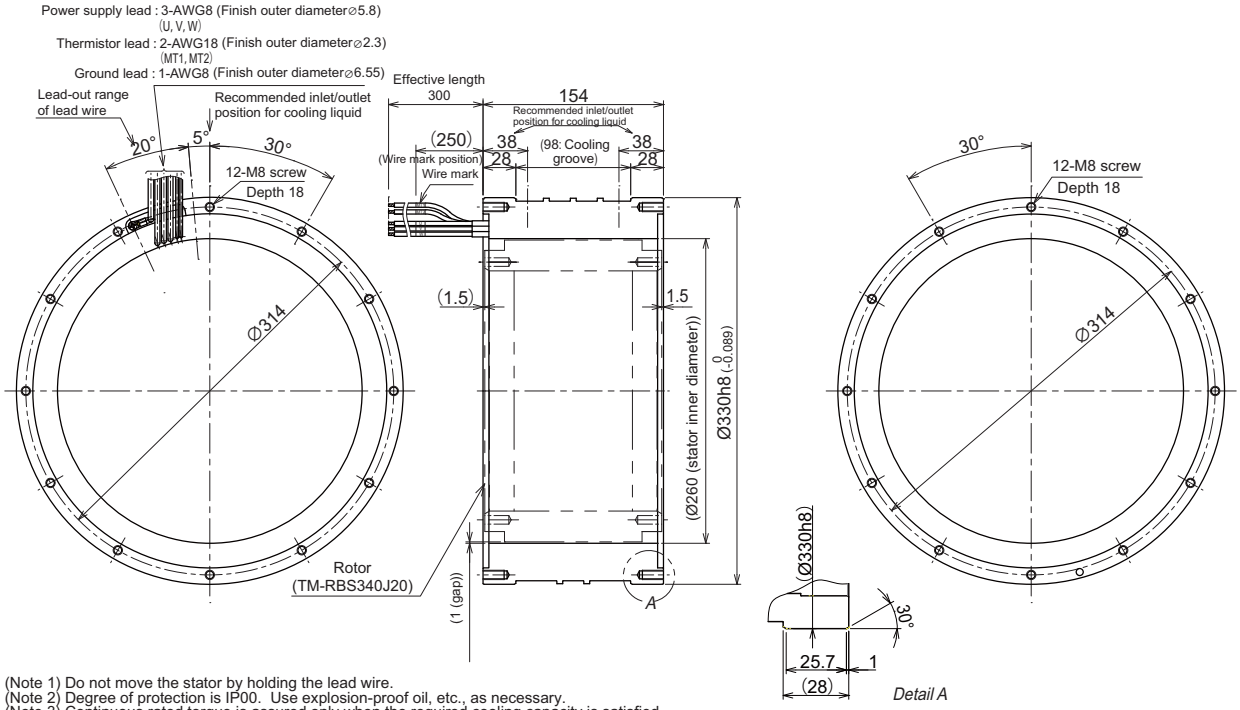
[Unit:mm]



(Note 1) Deliverable rotors are magnetized. Please note the magnetic attraction.
(Note 2) Take special care for the magnet part not to hit against a thing (A crack or chip may occur).
(Note 3) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBP340J20]

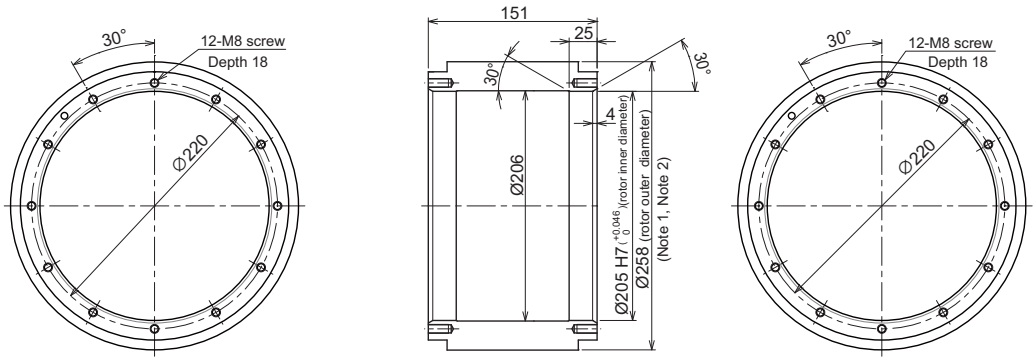
[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBS340J20]

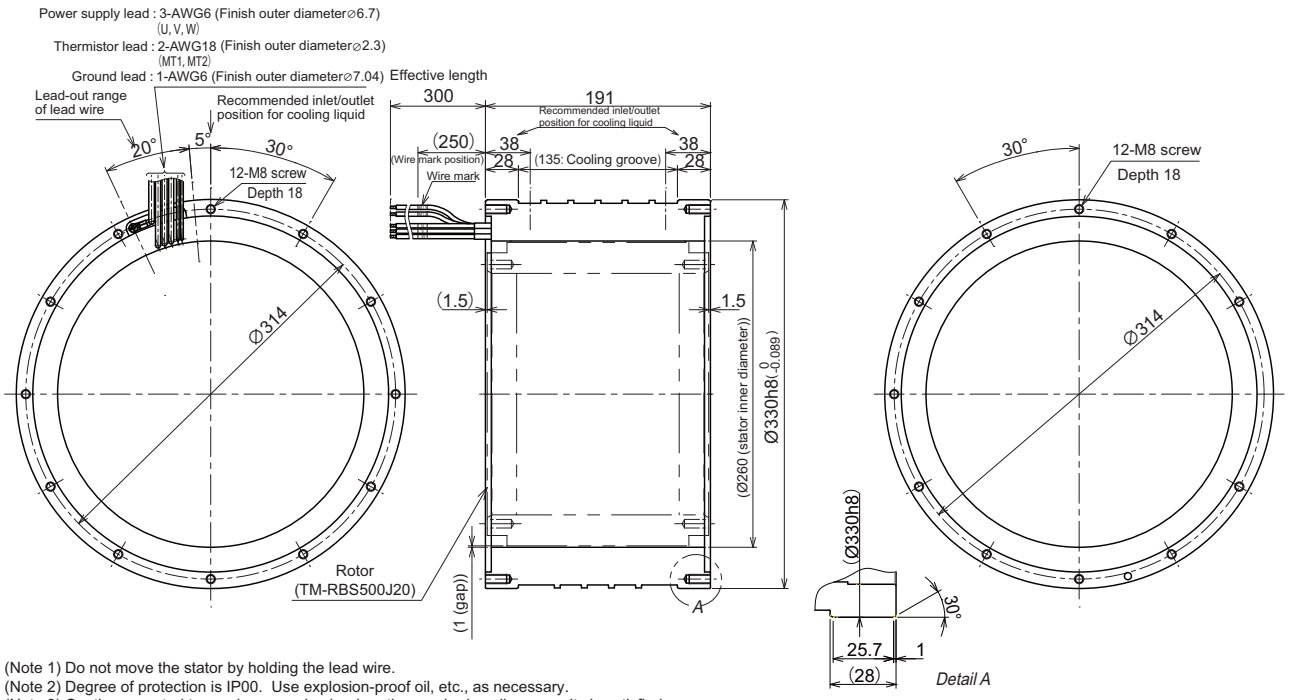
[Unit:mm]



(Note 1) Deliverable rotors are magnetized. Please note the magnetic attraction.
(Note 2) Take special care for the magnet part not to hit against a thing (A crack or chip may occur).
(Note 3) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBP500J20]

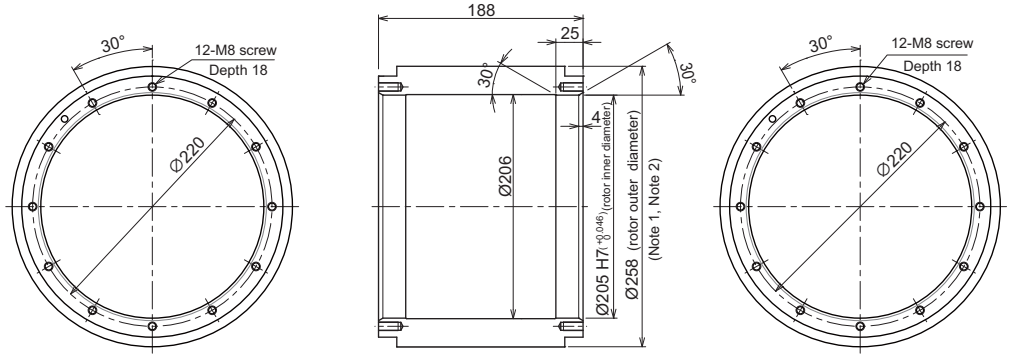
[Unit:mm]



(Note 1) Do not move the stator by holding the lead wire.
(Note 2) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 3) Continuous rated torque is assured only when the required cooling capacity is satisfied.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

[TM-RBS500J20]

[Unit:mm]



(Note 1) Deliverable rotors are magnetized. Please note the magnetic attraction.
(Note 2) Take special care for the magnet part not to hit against a thing (A crack or chip may occur).
(Note 3) Degree of protection is IP00. Use explosion-proof oil, etc., as necessary.
(Note 4) There is no problem on the functionality or performance even if the molded parts include sink marks or voids, etc.

3

Characteristics

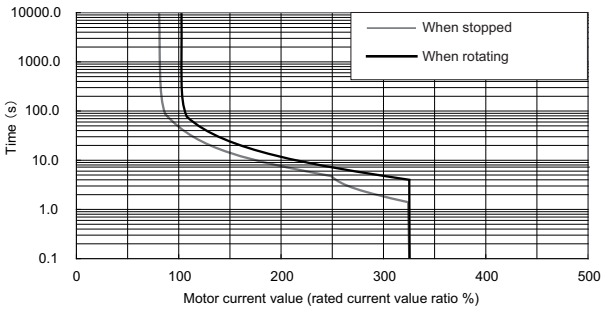
3-1 Direct-drive motor

3-1-1 Overload protection characteristics

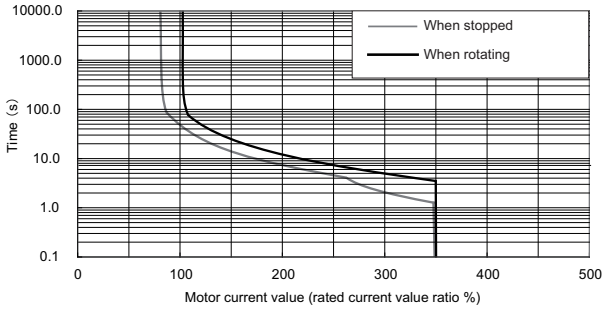
The servo drive unit has an electronic thermal relay to protect the motor and servo drive unit from overloads. The operation characteristics of the electronic thermal relay are shown below when standard parameters (SV021=60, SV022=150) are set. If overload operation over the electronic thermal relay protection curve shown below is carried out, overload 1 (alarm 50) will occur. If the maximum torque is commanded continuously for one second or more due to a machine collision, etc., overload 2 (alarm 51) will occur.

< MDS-D2 Series >

TM-RBP012C20



TM-RBP036E20



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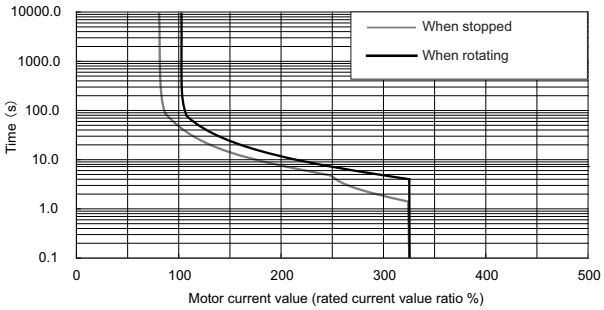

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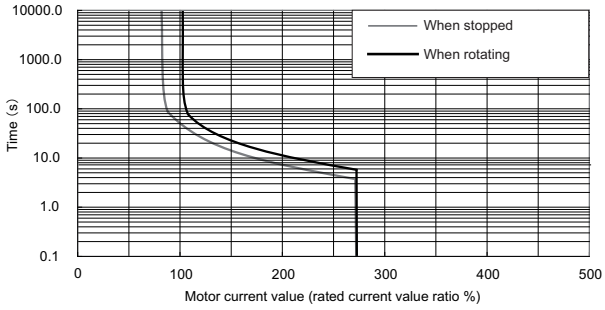
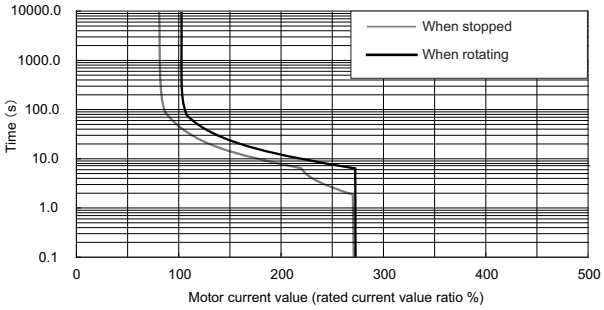
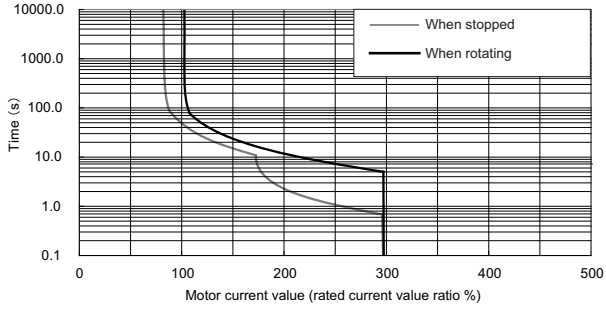


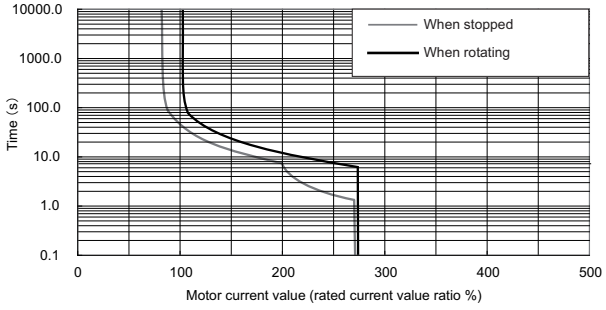
TM-RBP105G20



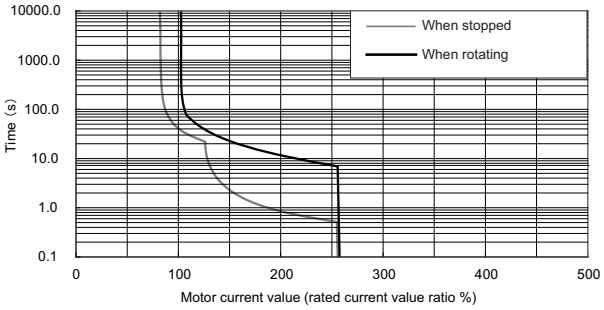
TM-RBP150G20



TM-RBP340J20

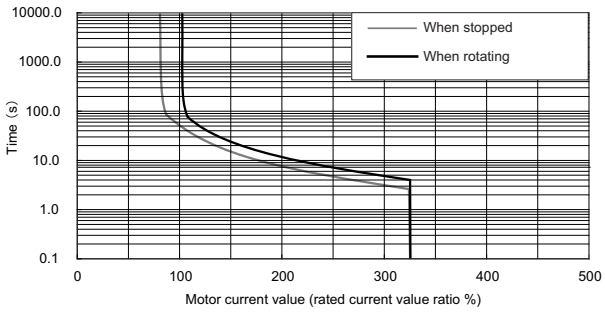


TM-RBP500J20

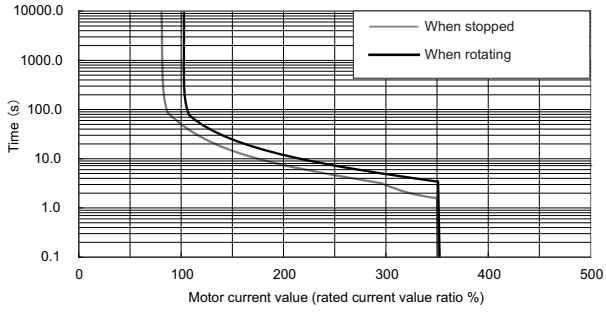


< MDS-DJ Series >

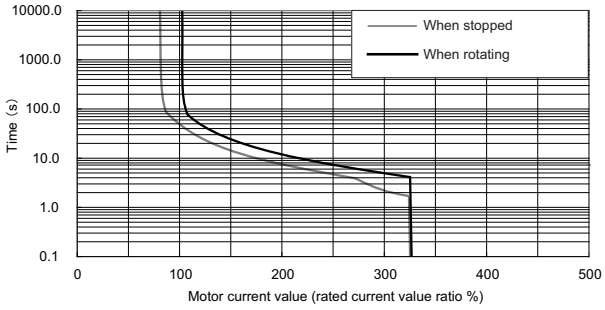
TM-RBP012C20



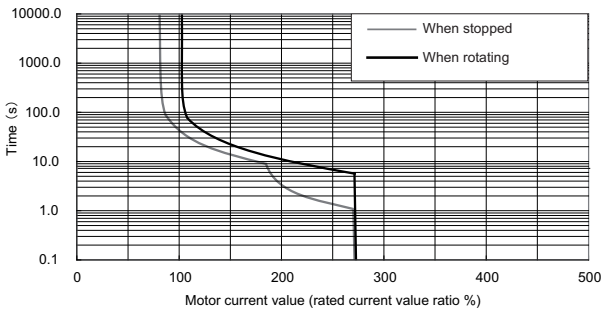
TM-RBP036E20



TM-RBP048G20



TM-RBP105G10

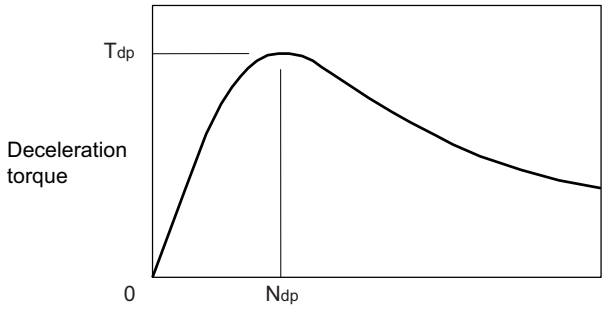


3-1-2 Dynamic brake characteristics

If a servo alarm that cannot control the motor occurs, the dynamic brakes will function to stop the direct-drive motor regardless of the parameter settings.

(1) Deceleration torque

The dynamic brake uses the motor as a generator, and obtains the deceleration torque by consuming that energy with the dynamic brake resistance. The characteristics of this deceleration torque have a maximum deceleration torque (Tdp) regarding the motor speed as shown in the following drawing. The torque for each motor is shown in the following table.



Deceleration torque characteristics of a dynamic brake

< MDS-D2 Series >

Max. deceleration torque of a dynamic brake

Motor type	Rated torque (N•m)	Tdp (N•m)	Ndp (r/min)
TM-RBP012C20	12.0	32.15	2125
TM-RBP036E20	36.0	168.89	2416
TM-RBP048G20	48.0	197.39	1253
TM-RBP105G10	105.0	310.09	929
TM-RBP105G20	105.0	300.32	1124
TM-RBP150G20	150.0	422.03	1199
TM-RBP340J20	340.0	1736.57	2457
TM-RBP500J20	500.0	2266.02	1943

< MDS-DJ Series >

Max. deceleration torque of a dynamic brake

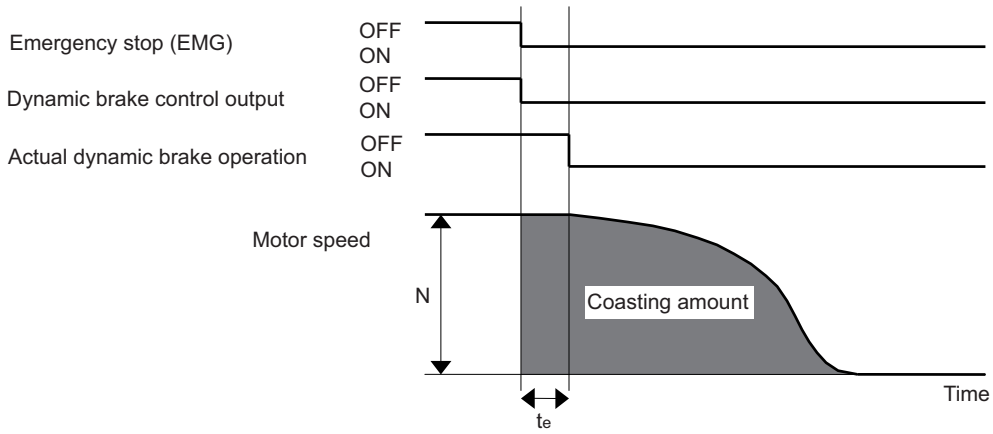
Motor type	Rated torque (N•m)	Tdp (N•m)	Ndp (r/min)
TM-RBP012C20	12.0	32.15	2258
TM-RBP036E20	36.0	168.89	2679
TM-RBP048G20	48.0	197.39	1425
TM-RBP105G10	105.0	310.09	1442

(2) Coasting rotation distance during emergency stop

The angle that the motor coasts when stopping with the dynamic brakes can be approximated with the following expression.

$$L_{MAX} = \frac{F}{60} \cdot \{ t_e + (1 + \frac{J_L}{J_M}) \cdot (A \cdot N^2 + B) \}$$

L_{MAX}	: Motor coasting angle	[deg]
F	: Axis feedrate	[deg/min]
N	: Motor speed	[r/min]
J_M	: Rotor inertia	[kg•cm^2]
J_L	: Motor shaft conversion load inertia	[kg•cm^2]
t_e	: Brake drive relay delay time	[s] (Normally, 0.03s)
A	: Coefficient A (Refer to the next page)	
B	: Coefficient B (Refer to the next page)	



Dynamic brake braking diagram

< MDS-D2 Series >

Coasting amount calculation coefficients table

Motor type	J_M (kg•cm^2)	A	B
TM-RBP012C20	22	3.51×10^{-9}	7.62×10^{-3}
TM-RBP036E20	127	7.64×10^{-9}	9.51×10^{-3}
TM-RBP048G20	280	27.79×10^{-9}	9.30×10^{-3}
TM-RBP105G10	393	33.49×10^{-9}	6.16×10^{-3}
TM-RBP105G20	395	28.73×10^{-9}	7.74×10^{-3}
TM-RBP150G20	510	24.73×10^{-9}	7.59×10^{-3}
TM-RBP340J20	2778	28.41×10^{-9}	20.58×10^{-3}
TM-RBP500J20	3538	35.06×10^{-9}	15.89×10^{-3}

< MDS-DJ Series >

Coasting amount calculation coefficients table

Motor type	J_M (kg•cm^2)	A	B
TM-RBP012C20	22	3.31×10^{-9}	8.09×10^{-3}
TM-RBP036E20	127	6.89×10^{-9}	10.55×10^{-3}
TM-RBP048G20	280	24.43×10^{-9}	10.59×10^{-3}
TM-RBP105G10	395	21.67×10^{-9}	9.62×10^{-3}

4

Dedicated Options

4-1 Detector system options

The option units are required depending on the detector system configuration. Check the option units to be required referring the following items. Refer to the Specifications manual of the drive unit to be used for details of the battery options.

(1) Detector system configuration

The applicable absolute position detectors are as follows.

Manufacturer	Detector type	Interface unit type	Minimum detection resolution	Battery option	Remarks
Mitsubishi Electric Corporation	MBA405W Series	(Provided)	0.00009˚ (4,000,000p/rev)	Required	-
Magnescale Co., Ltd	RU77	Not required	0.0000429˚ (8,388,608p/rev)	Not required	-
			0.0000107 (33,554,432p/rev)	Not required	-
HEIDENHAIN	RCN223M	Not required	0.0000429˚ (8,388,608p/rev)	Not required	-
	RCN227M	Not required	0.0000027˚ (134,217,728p/rev)	Not required	-
	RCN727M RCN827M	Not required	0.0000027˚ (134,217,728p/rev)	Not required	Tolerable rotation speed 300r/min
MHI MACHINE TOOL ENGINEERING CO., LTD	MPRZ series	ADB-20J71	0.000043˚ (8,388,608p/rev)	Not required	-

<Contact information about other manufacturer's detector>
- Magnescale Co., Ltd.: http://www.mgscale.com/mgs/language/english/
- HEIDENHAIN CORPORATION: http://www.heidenhain.com/
- MHI MACHINE TOOL ENGINEERING CO., LTD.: http://www.mme-e.co.jp/

CAUTION ! **Confirm the specifications of each detector manufacturer before using detectors made by other manufacturers.**

4-1-1 Twin-head magnetic detector (MBA Series)

(1) Type description

MBA405W-B (1) (2)

(1)

Symbol	Drum outer diameter
E	Φ100 mm
F	Φ150.3 mm
G	Φ200.6 mm

(2)

Symbol	Drum inner diameter
082	Φ82 mm
125	Φ125 mm
160	Φ160 mm

(2) Specifications

Detector type		MBA405W-BE082	MBA405W-BF125	MBA405W-BG160
Electrical characteristics	Detector resolution	4,000,000p/rev		
	Detection method	Absolute position method (battery backup method)		
	Accuracy (*1)	± 4 seconds	± 3 seconds	± 2 seconds
	Wave number within one rotation	512 waves	768 waves	1024 waves
	Detector output data	Serial data		
	Power consumption	0.2A or less		
Mechanical characteristics for rotation	Inertia	0.5×10^{-3}kg・m^2	2.4×10^{-3}kg・m^2	8.7×10^{-3}kg・m^2
	Tolerable continuous rotation speed	3000r/min	2000r/min	1500r/min
Mechanical configuration	Drum inner diameter	ϕ82mm	ϕ125mm	ϕ160mm
	Drum outer diameter	ϕ100mm	ϕ150.3mm	ϕ200.6mm
	Drum mass	0.2kg	0.46kg	1.0kg
	Degree of protection (*2)	IP67		
Working environment	Ambient temperature range	0° C to +55° C		
	Storage temperature range	-20° C to +85° C		
	Humidity	95%RH		
	Vibration resistance	Horizontal direction to the axis: 5G or less, Vertical direction to the axis: 5G or less		
	Impact resistance	490m/s^2 (50G)		

(*1) The values above are typical values and are not guaranteed.
(*2) It is the degree of protection when fitted with a connector.

(3) Specifications of preamplifier

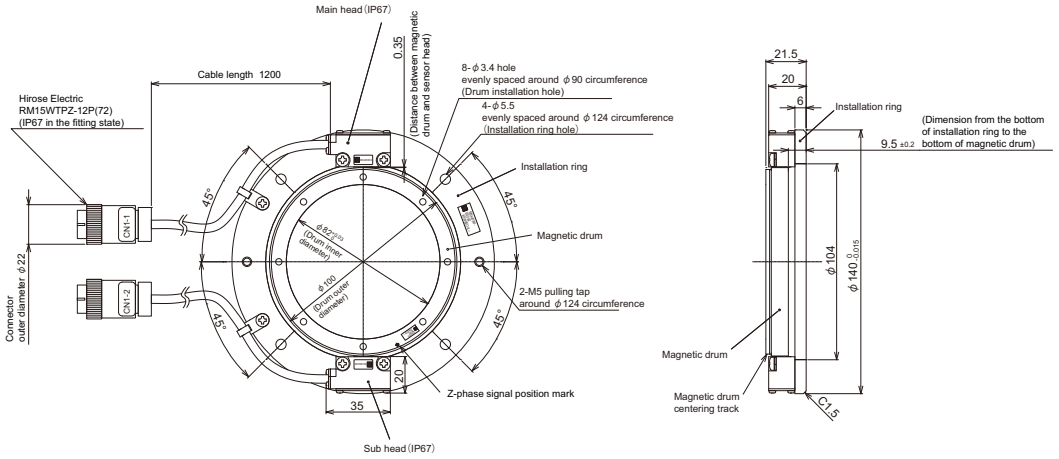
Item	Specified value
Output communication style	High-speed serial communication I/F
Working ambient temperature	0° C to +55° C
Working ambient humidity	90%RH or less (with no dew condensation)
Atmosphere	No toxic gases
Tolerable vibration	Horizontal direction to the axis: 5G or less, Vertical direction to the axis: 5G or less
Tolerable impact	490m/s^2 (50G)
Tolerable power voltage	DC5V ± 10%
Mass	0.33kg
Degree of protection	IP67

(*1) The values above are the specified values for the preamplifier provided with a twin-head magnetic detector.
(*2) It is the degree of protection when fitted with a connector.

(4) Outline dimension drawing

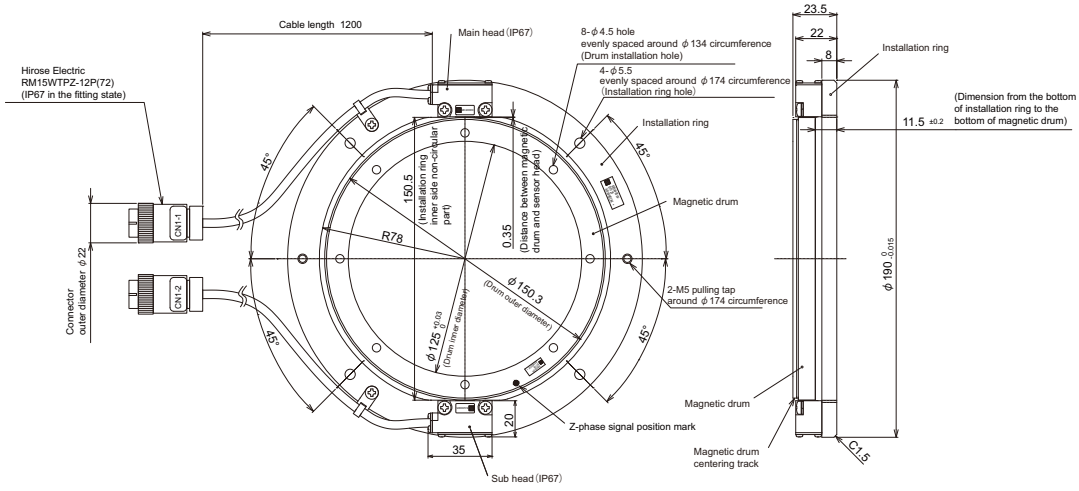
< MBA405W-BE082 >

[Unit: mm]]



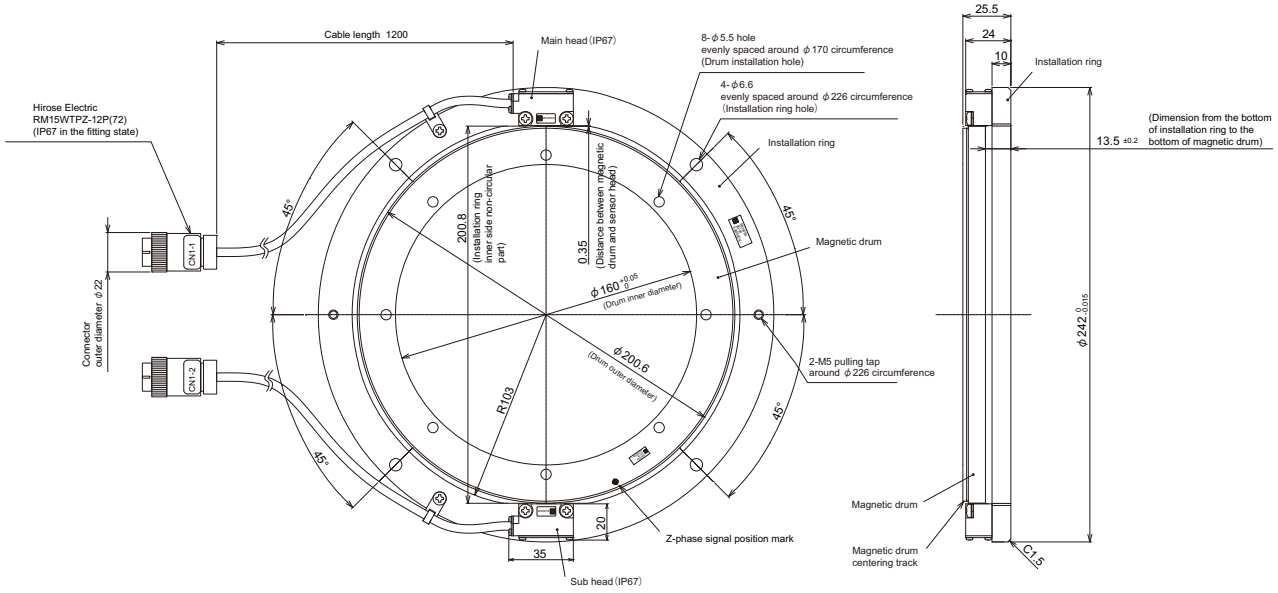
< MBA405W-BF125 >

[Unit: mm]]



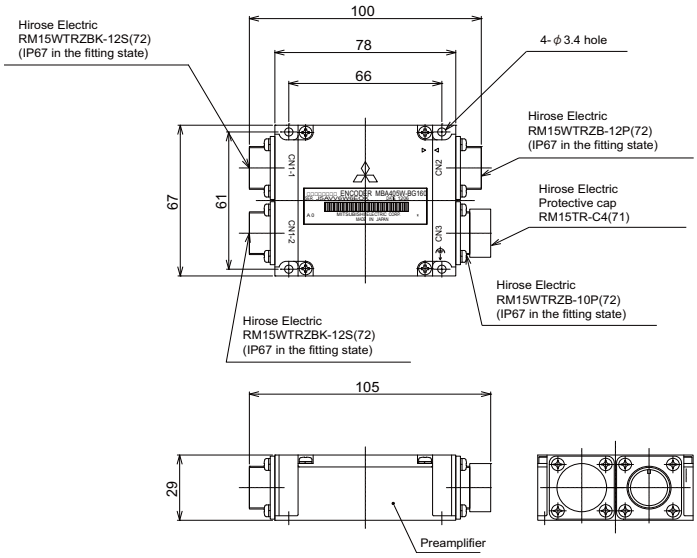
< MBA405W-BG160 >

[Unit: mm]



< Preamplifier (common) >

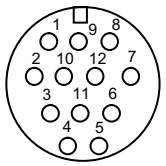
[Unit: mm]



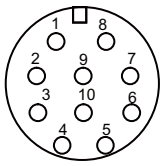
< Explanation of connectors >

Connector name	Application
CN1-1	For connection with scale (main head)
CN1-2	For connection with scale (sub head)
CN2	For connection with servo drive unit
CN3	For connection with motor thermistor

< Connector pin layout >



CN2 < Drive unit >



CN3 < Thermistor>

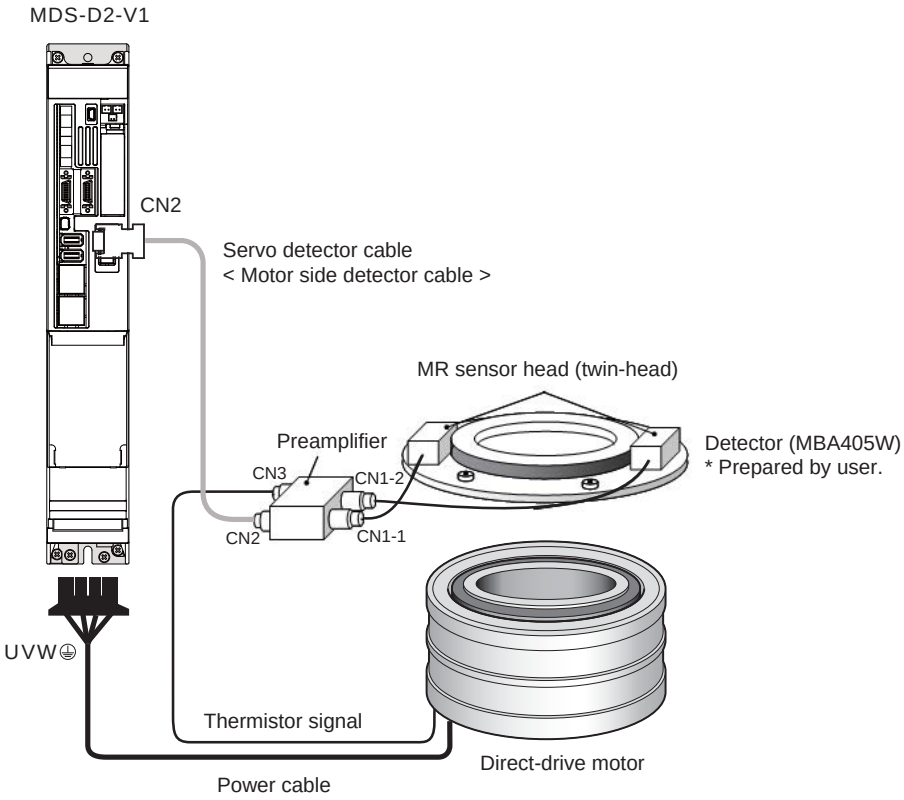
Pin No.	Function	Pin No.	Function
1	-	**1**	-
2	BT	**2**	-
3	SD	**3**	MT1
4	SD*	**4**	-
5	SHD	**5**	-
6	MT1	**6**	-
7	RQ	**7**	-
8	RQ*	**8**	-
9	P5	**9**	MT2
10	LG	**10**	-
11	MT2	**11**	-
12	CNT	**12**	-

4-2 Cables and connectors

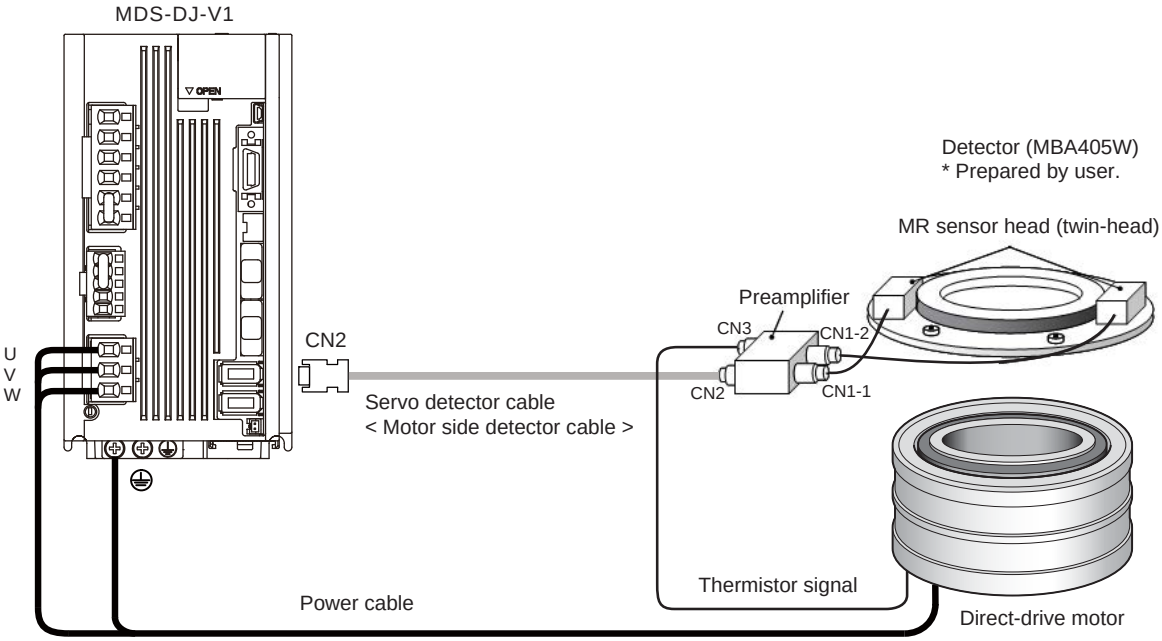
4-2-1 Cable connection diagram

The cables and connectors that can be ordered from Mitsubishi Electric Corp. as option parts are shown below. Cables can only be ordered in the designated lengths. Purchase a connector set, etc., to create special length cables.

< MDS-D2 Series >



< MDS-DJ-V1 Series >



4-2-2 List of cables and connectors

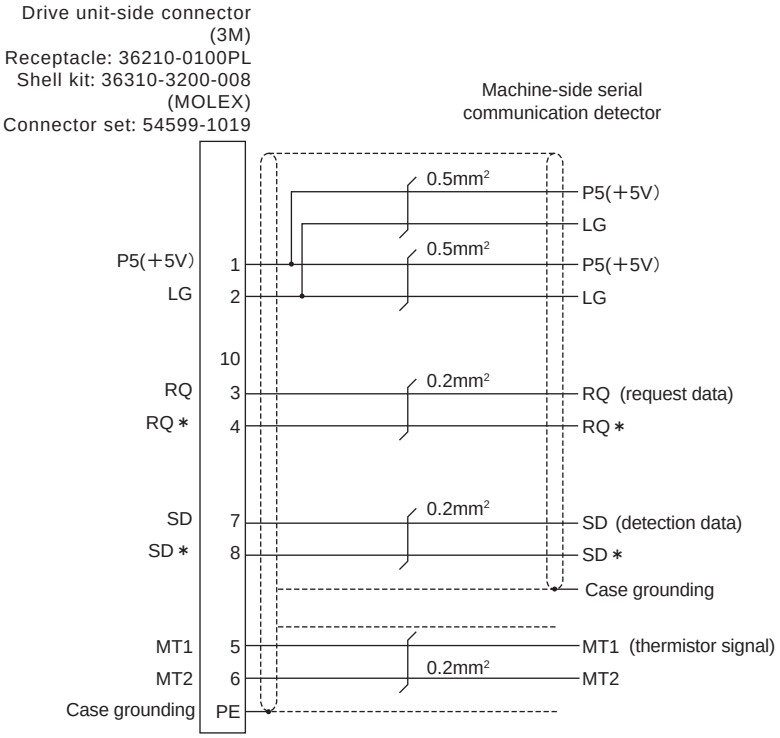
< Servo detector cable and connector >

Item		Model	Contents
For CN2	Detector connector	CNU2S(AWG18)	Drive unit side connector (3M) Receptacle: 36210-0100PL Shell kit : 36310-3200-008 (MOLEX) Connector set: 54599-1019
	Cable for MBA405W	CNV2E-MB- ☐ M ☐ : Length 2, 3, 4, 5, 7, 10, 15, 20m	Drive unit side connector (3M) Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (MOLEX) Connector set: 54599-1019 Detector preamplifier side connector (Hirose Electric) Plug: RM15WTPZK-12S Clamp: JR13WCCA-8 (72)
	Connector for MBA405W	CNEMB2S(8)	Detector preamplifier side connector (Hirose Electric) Plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8 (72)
For CN3	Thermistor connector for MBA405W	CNEMB3S(8)	Detector preamplifier side connector (Hirose Electric) Plug: RM15WTPZ-10S Cord clamp: JR13WCCA-8 (72)

< Power connector >

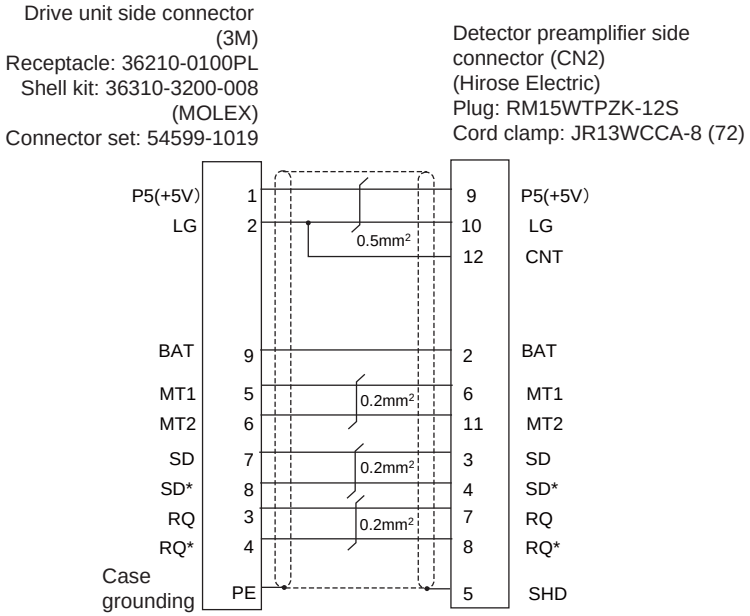
Item		Model	Contents
For TE1	Power connector for MDS-D2-V1-20 to 80 MDS-D2-V2-2020 to 8080 MDS-D2-SP-20 to 80 MDS-D2-SP2-2020 to 4040	CNU1S(AWG14)	Drive unit side power connector (DDK) Housing: DK-5200S-04R Contact : DK-5RECSLP1-100
	Power connector for MDS-D2-V1-160 MDS-D2-V2-16080,160160 MDS-D2-SP2-8040,8080	CNU1S(AWG10)	Drive unit side power connector (DDK) Housing: DK-5200S-04R Contact : DK-5RECMLP1-100

< Cable drawing >

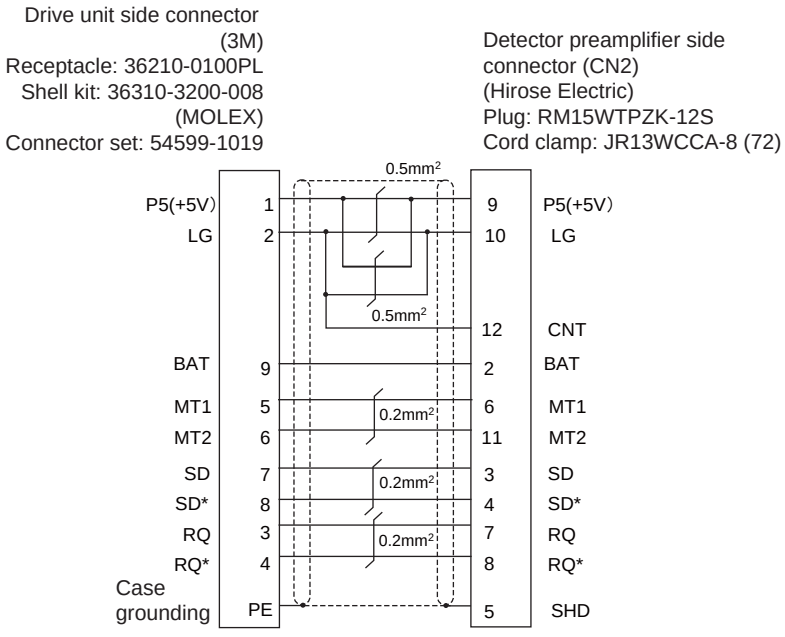


(Note) Contact the relevant manufacturer about whether or not the P5V wiring is necessary.

< Twin-head magnetic detector (MBA405W) connection diagram >

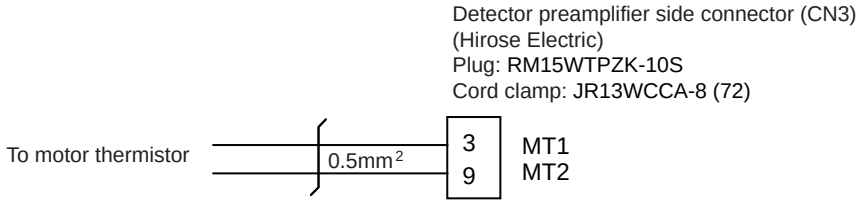


< For 10m or less >



< For 10m to 20m >

< Twin-head magnetic detector(MBA405W) motor thermistor cable connection diagram >



5

Selection

5-1 Selection of the power supply unit (only MDS-D2-V1/V2)

For the power supply unit, calculate the spindle motor output, servo motor output and direct-drive motor output each, and select the capacity satisfying the required rated capacity and the maximum momentary output. For details on the calculation method of motor output and selecting method for motors other than a direct-drive motor, refer to "MDS-D2/DH2 Series Instruction Manual".

5-1-1 Calculation of direct-drive motor output

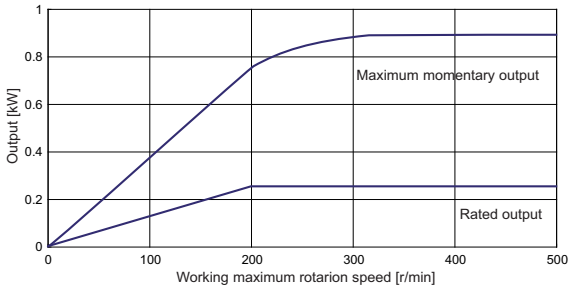
(1) Selection with rated output

(2) Selection with maximum momentary output

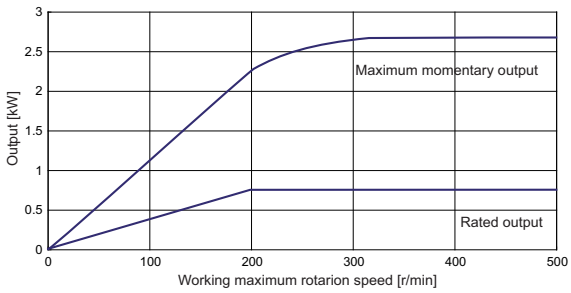
For the rated output and maximum momentary at the maximum speed of the direct-drive motor, calculate from the output characteristics of each motor.

< Output characteristics >

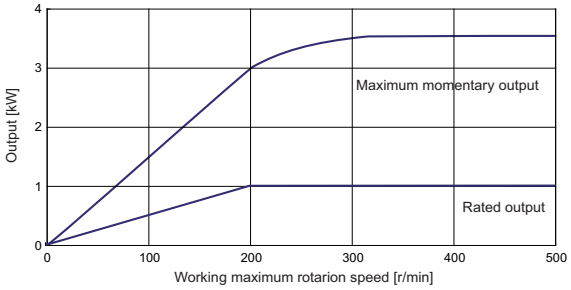
TM-RBP012C20



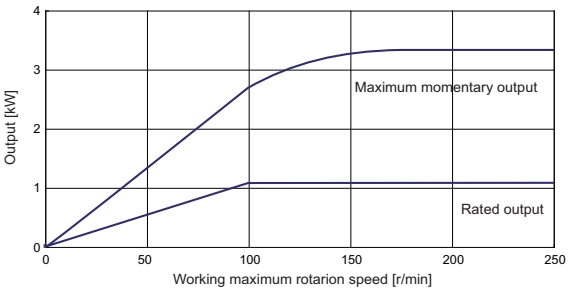
TM-RBP036E20



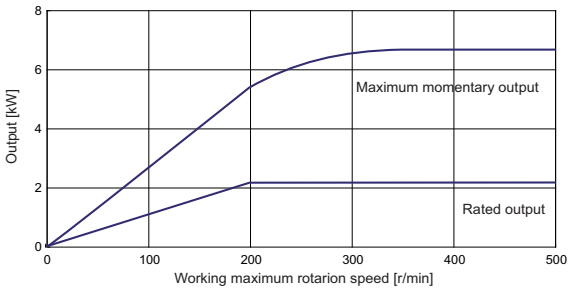
TM-RBP048G20



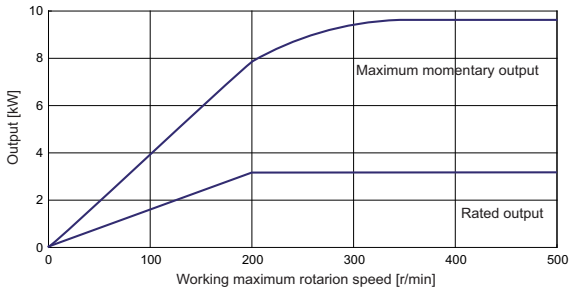
TM-RBP105G10



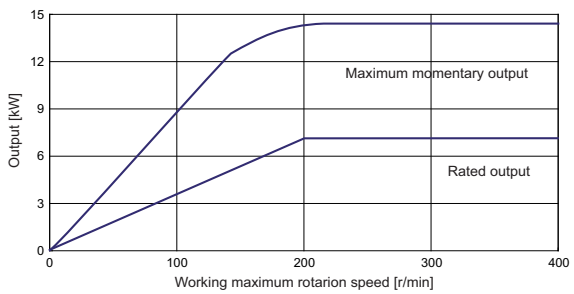
TM-RBP105G20



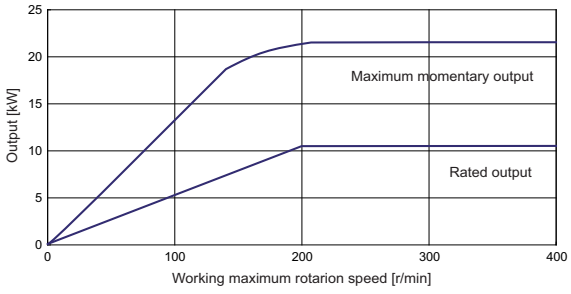
TM-RBP150G20



TM-RBP340J20



TM-RBP500J20



6

Assembly and Installation

6-1 Installation

⚠DANGER

1. Installation must be done by a qualified technician.
2. Pay attention so that a person with a medical device such as pacemaker won't approach the product. The device may be affected by the permanent magnets.
3. Do not place magnetic material such as iron close to the product.
4. Before installing, remove metal items such as watch, piercing jewelry, necklace, etc.
5. In installing the product and peripheral structures, make sure to use nonmagnetic tools.
6. Do not leave the product (primary and secondary side) unattended.
7. Immediately stop using the product if any abnormality is found about the product.
8. When multiple operators are engaged in the operation, confirm that no operator is within the range of motion before energizing the product. If any operator remains in the range of motion, take measures to prevent the motion with interlock system, etc.
9. As the motor doesn't have the holding power when it is not energized, if you use the product not as a vertical axis, take measures to prevent the axis from rotating due to gravity.

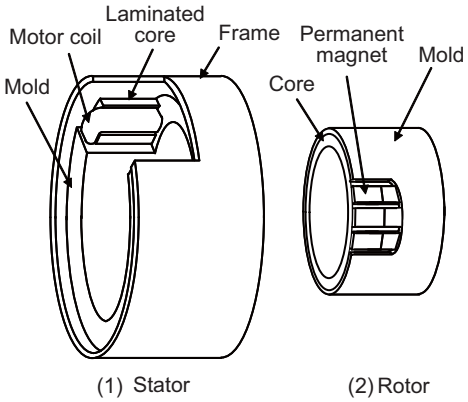
⚠CAUTION

1. Do not arrange the product, or do not give a shock.
2. Do not get on top of or place heavy objects on the product.
3. Correctly and securely perform the wiring.
   Especially, fix the terminals or connectors of the power cables firmly enough.
4. Perform the wiring after installing the product to the machine and device.
5. If iron chips, etc. adhere to the product during installation, completely remove them.
6. Do not install with wet hands.

6-2 The structure of direct-drive motor

(1) Stator

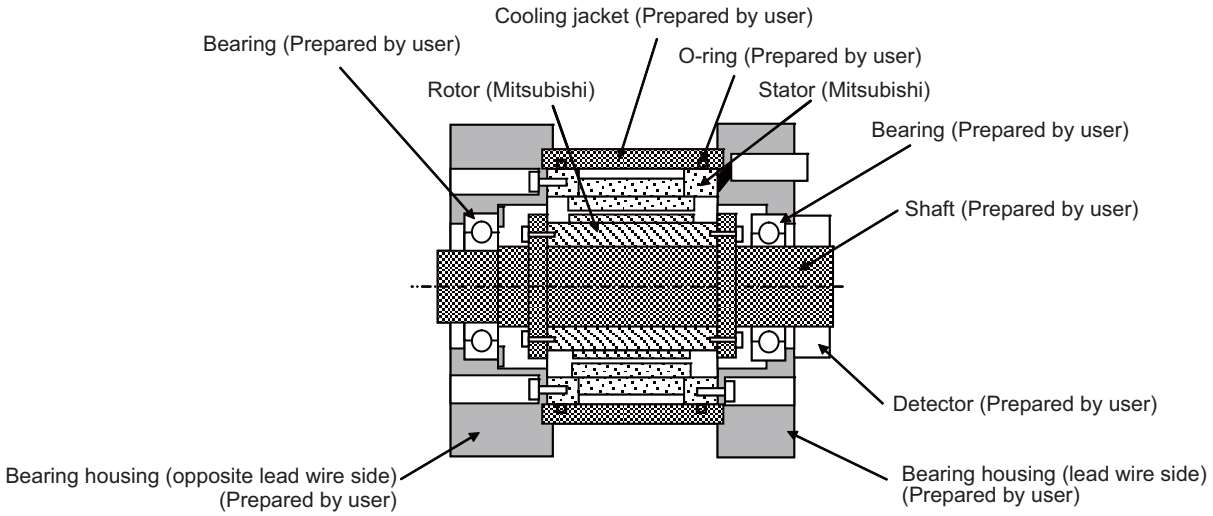
The stator has laminated cores to which windings are applied. The cores are protected by mold.
Compared with metal parts, the mold is susceptible to breaking or cracking due to shock or stress, which may deteriorate the product's quality. Pay special attention in carrying and installing not to damage the mold.



(2) Rotor

Permanent magnets are on the core of the rotor, and mold is applied to the surface of it. As it has permanent magnets, magnetic attraction force is generated between it and magnetic material as iron. The magnetic attraction force is generated mainly on the magnet side (outer surface of rotor). (Almost no attraction force is generated on the inner surface.)
Take safety measure in handling to avoid accidents due to the attraction force. In addition, the magnetic force is released into the air, so do not make devices that are affected by the magnetic force such as pacemaker, watch, etc. approach to the product.

< Example of direct-drive motor structure >


Cooling jacket (Prepared by user)
Bearing (Prepared by user)
O-ring (Prepared by user)
Rotor (Mitsubishi)
Stator (Mitsubishi)
Bearing (Prepared by user)
Shaft (Prepared by user)
Detector (Prepared by user)
Bearing housing (opposite lead wire side) (Prepared by user)
Bearing housing (lead wire side) (Prepared by user)

⚠ CAUTION

1. O-rings for the cooling jacket are required to carry out a forced liquid cooling of the motor. O-rings are not provided with this motor, so the optimum ones should be prepared by users.

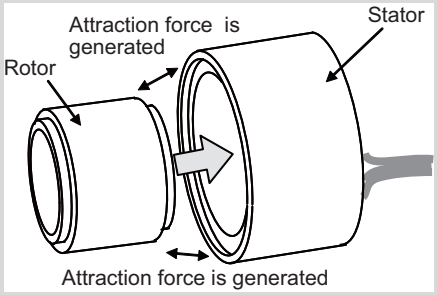
2. The motor's lead wires are non movable cables. Fix the lead wire section not to move. The bending radius of the lead wires should be five times or more than its own diameter.

3. Make sure to take dust- and water-proof measures since this motor is rated IP00. The protection class of the motor assembling section should be IP54 or higher. If foreign matters enter the gap between the stator and the rotor, trouble may occur. Additionally, continuous exposure to oil or water may cause insulation degradation or rust.

6-3 Direct-drive motor assembly

⚠ CAUTION

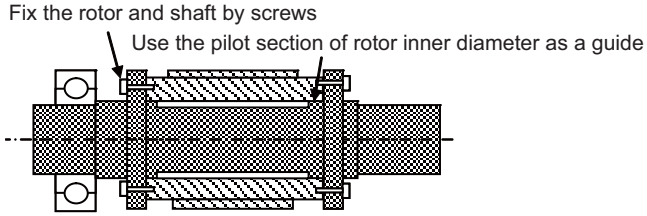
1. **As a magnetic attraction force is generated on the rotor of direct-drive motor, take measures such as using nonmagnetic tools at the time of assembly.**
2. **A magnetic attraction force of about 200N (stator outer diameter φ130) to 1300N (stator outer diameter φ330) will be generated when a rotor is inserted into a stator. Take necessary and sufficient safety measures such as using a jig considering the attraction force. Otherwise the rotor may suddenly be attracted to the stator during assembling, resulting in a great danger.**



6-3-1 Example procedure of assembly

(1) Shaft assembly

Fit a shaft into the rotor using the pilot section of rotor inner diameter as a guide.
Use the screw holes on the rotor ends to fix the rotor and shaft by screws. Use as many holes on the both ends as possible to fix them.

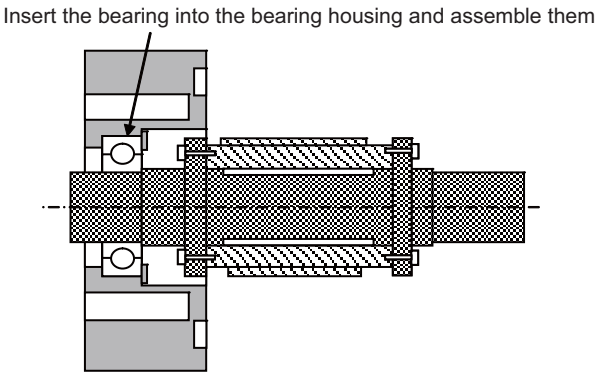


⚠ CAUTION

1. **Do not raise the temperature of the rotor to 40°C or higher before assembling since heat may demagnetize magnets. Do not shrink-fit the rotor.**
2. **The rotor has not balanced. If the balance of the rotor is a problem, adjust the dynamic balance after assembling the shaft to the rotor. Take special care for the magnetic attraction force acted on the rotor surface when balancing. Use the shaft part for balancing. Do not machine the rotor itself or install balancing screws.**

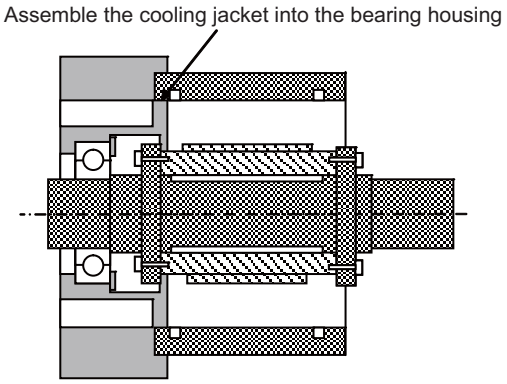
(2) Shaft and bearing housing assembly

Insert the bearing into the bearing housing and assemble to fix them.



(3) Cooling jacket assembly

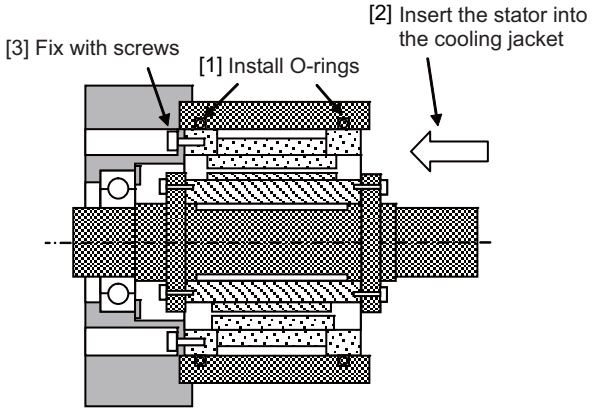
Assemble the cooling jacket by using the pilot section of bearing housing as a guide.
Perform the centering of the rotor and stator using the cooling jacket inner diameter as a guide.



⚠CAUTION **Make sure that the concentricity deviation of the rotor inner diameter to the stator outer diameter is 0.1mm or smaller at the both fitting sections. (Keep them as concentric as possible.)**

(4) Stator assembly

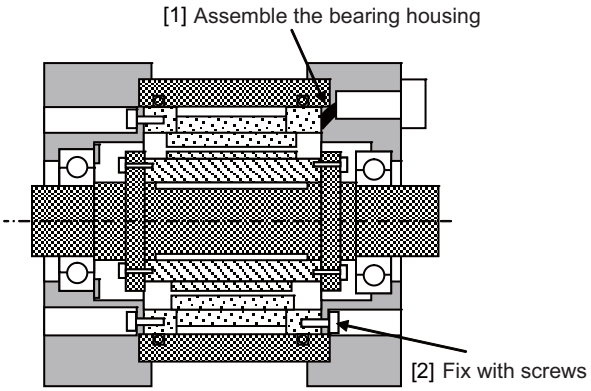
[1] Install O-rings to the cooling jacket.
[2] Insert the stator using the cooling jacket inner diameter as a guide.
[3] Fix the stator to the housing with screws.



(5) Bearing housing assembly

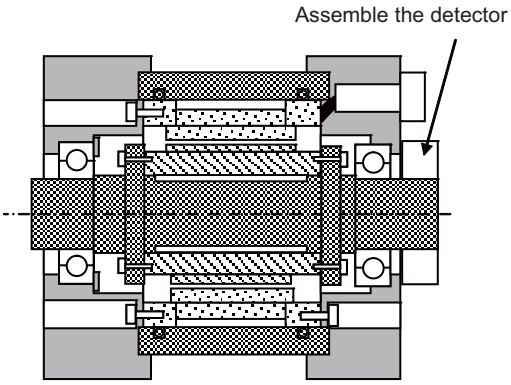
[1] Assemble the other bearing and then assemble the bearing housing by using the pilot section of the cooling jacket as a guide.

[2] Fix the stator to the housing with screws.
Use as many screw holes on the both ends as possible to fix them.



(6) Detector assembly

Assemble the detector into the shaft end.



⚠ CAUTION

If the rotor rotates clockwise (right-hand turning) when viewed from the power line side, this direction is considered as plus (+) of the motor. When the rotation direction of the motor and plus direction of the detector do not match, set the detector installation polarity with the following parameter at the initial setup.

- #2217/bit0(SV017/bit0)

0: Forward polarity 1: Reverse polarity

Refer to the section "7-2 Initial setup for the direct-drive motor system" for details.

6-4 Installing twin-head magnetic detector (MBA405W Series)

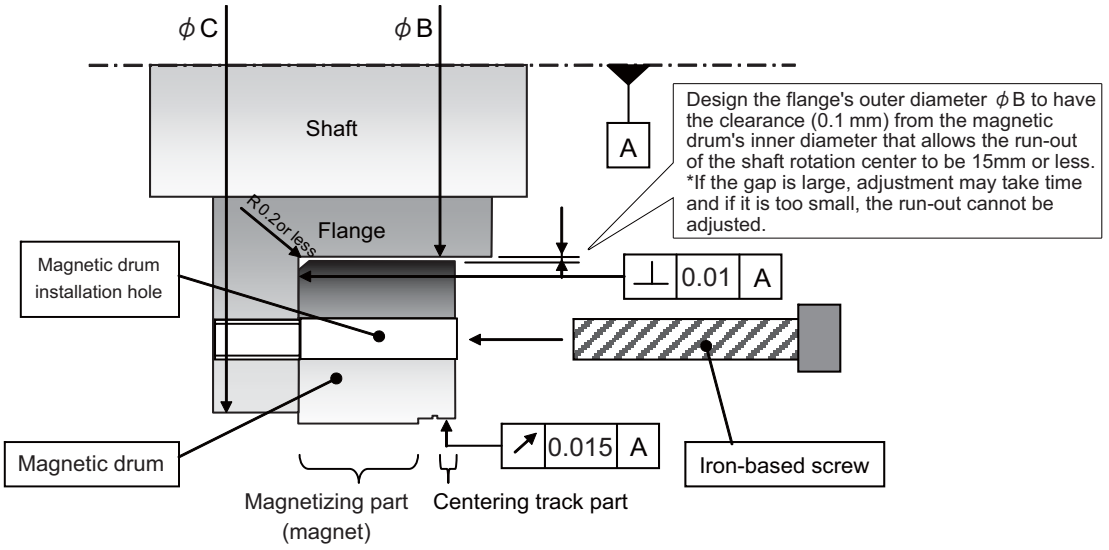
⚠ CAUTION

1. Handle with care as this is a precision component. Especially, do not apply external force on the sensor head component (thin metal film section) and the magnetized section (magnet) of the magnetic drum.
2. Pay attention not to apply excessive external force on the product by hauling the sensor head cable strongly or by hanging the installation ring with holding the cable. Applying such force will cause a fault.
3. The magnetic drum has magnets in it. Pay attention so that any magnetic dust will not adhere on the drum. If any dust adheres on it, remove it using air blow.
4. Do not make magnetic screw drivers or tools touched the magnetized section of the magnetic drum during installation.
5. Use iron screws (carbon steel, chromium molybdenum steel) for fixing the magnetic drum.
6. This product is equivalent of IP67 (IP67 is realized when cables are connected to all connectors). Note that, however, if the liquid such as oil, cutting fluid or water is constantly splashed on the product, it may cause a fault. Make sure to provide measures against splash on the machine side as much as possible.
7. Connect the preamp to the ground. Screw the preamp cabinet on the machine for grounding.
8. If the CN3 connector of the preamp is not used when using the product, leave the cap on it to prevent water from entering.
9. This product has been adjusted as a set of magnetic drum, installation ring (with main head and sub head) and preamp of the same serial No. So use this product as a set of those components. Make sure that it is not possible to mix a component of a different serial No. in the set.

(1) Installing a magnetic drum

Install a flange on the shaft side and fix with screw in the axial direction by using the magnetic drum installation hole. Center the core with centering track so that the amplitude to the shaft rotation center is 15μm or less to install the magnetic drum.

[Unit:mm]


ϕC
ϕB
Shaft
A
Design the flange's outer diameter ϕB to have the clearance (0.1 mm) from the magnetic drum's inner diameter that allows the run-out of the shaft rotation center to be 15mm or less.
*If the gap is large, adjustment may take time and if it is too small, the run-out cannot be adjusted.
R0.2or less
Flange
Magnetic drum installation hole
⊥ 0.01 A
↗ 0.015 A
Magnetic drum
Iron-based screw
Magnetizing part (magnet)
Centering track part

⚠CAUTION

1. To avoid the interference with the sensor head, design the flange outer diameter φC so that it is equal to the magnetic drum outer diameter or less.

2. Fix the magnetic drum with screw on the shaft. (Do not fix with shrink fitting.)

3. Center the core with centering track. Do not perform by striking on the magnetizing part as it may result in damages.

4. Adherence of magnetic materials to the magnetizing part could lead to incorrect detections. Perform an air blow when the core alignment is completed.

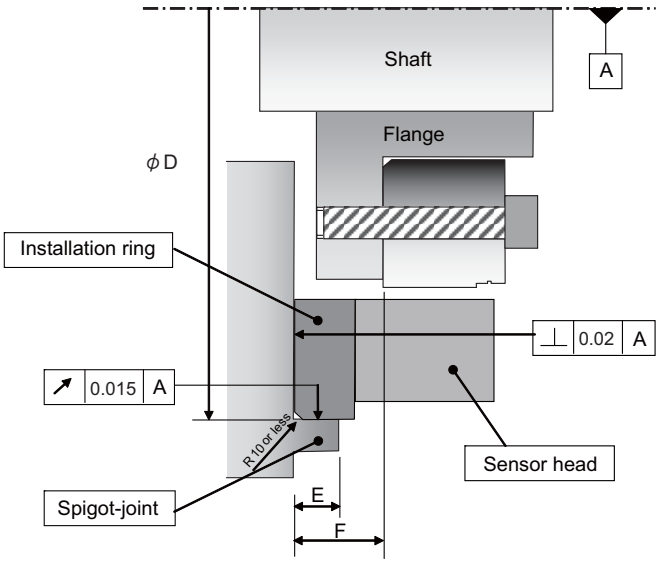
Type	Centering track outer diameter [mm]	Magnetic drum installation hole position [mm]	Installation screw	Recommended screw torque [N•m]
MBA405W-BE082 MBE405W-BE082	ϕ98	8-ϕ3.4 through (evenly spaced around ϕ90 circumference)	M3	0.61 to 0.83
MBA405W-BF125 MBE405W-BF125	ϕ148.3	8-ϕ4.5 through (evenly spaced around ϕ134 circumference)	M4	1.39 to 1.89
MBA405W-BG160 MBE405W-BG160	ϕ198.6	8-ϕ4.5 through (evenly spaced around ϕ170 circumference)	M5	2.75 to 3.63

(2) Installing a installation ring

Create a spigot-joint on machine side and fit the installation ring on the inner diameter of the spigot-joint to install the installation ring. Ensure the accuracy for the dimension of machine side spigot-joint as shown below so as not to degrade the detection accuracy.

Confirm the gap between the magnetic drum and the sensor head is secured by 0.29mm or more with clearance gauge etc. after the installation.

[Unit:mm]



⚠ CAUTION

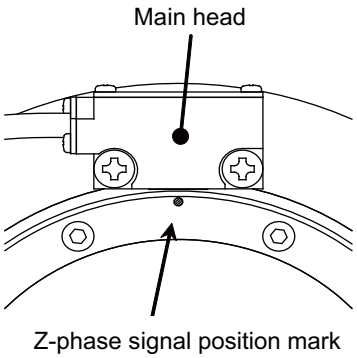
1. **Do not contact to the magnetic drum when installing the installation ring as it may result in damages of magnetic drum or sensor head.**
2. **The sensor head is joined after adjusting the positional relationship with the installation ring beforehand, so do not remove the sensor head fixing screw.**
3. **Create a spigot-joint as close to the machine side and fit the installation ring on the spigot-joint to install. Do not center the core by striking on the installation ring outer diameter. etc.**
4. **Adherence of foreign materials to the element part of the sensor head (metallic thin film part) could lead to incorrect detections. Remove with an air blow when foreign materials are adhered so as not to damage them.**

[Unit:mm]

Type	Installation ring outer diameter	Spigot-joint inner diameter (ϕD)	Spigot-joint height (E)	Height from installation ring bottom surface to magnetic drum bottom surface (F)
MBA405W-BE082 MBE405W-BE082	$\phi 140\ ^{0}_{-0.015}$	$\phi 140\ ^{+0.015}_{0}$	3.0 to 5.5	9.5 ± 0.2
MBA405W-BF125 MBE405W-BF125	$\phi 190\ ^{0}_{-0.015}$	$\phi 190\ ^{+0.015}_{0}$	3.0 to 7.5	11.5 ± 0.2
MBA405W-BG160 MBE405W-BG160	$\phi 242\ ^{0}_{-0.015}$	$\phi 242\ ^{+0.015}_{0}$	3.0 to 9.5	13.5 ± 0.2

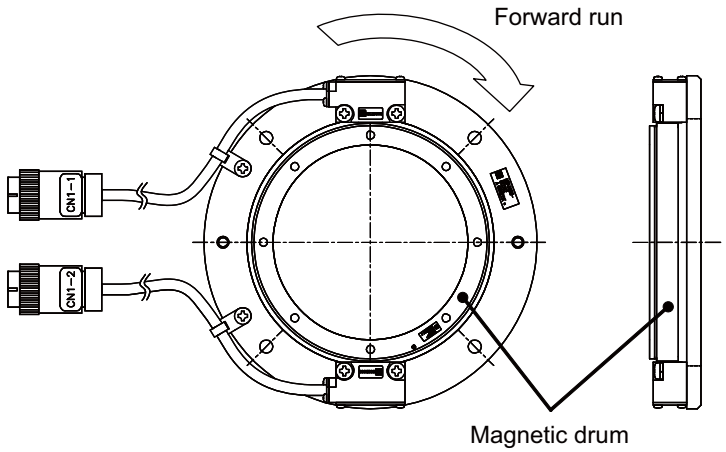
(3) For Z-phase signal detection

After turning the detector power ON, Z-phase signal is required to be detected by the main head (Z-phase signal position mark is required to pass the main head). For the device configuration which the magnetic drum cannot drive more than one rotation, install the detector so that Z-phase can pass the main head in the shaft stroke.



(4) For the rotation direction of the detector

Seeing a detector from the upper surface as shown below, when the magnetic drum rotates clockwise is the forward run. Confirm the rotation direction of the detector and motor by reference to each motor specifications.



(5) For MBA405W (absolute detector)

The initial setup operation is required after the operation is enabled for NC system to connect MBA405W to the servo drive unit. Refer to "7-3 Initial setup for the direct-drive motor system when using MBA405W" for details. The initial setup is required only for the first time after installing the detector to the machine.

7

Setup

7-1 Setting the initial parameters for the direct-drive motor

The servo parameters must be set before the direct-drive motor can be started up. The servo parameters are input from the NC. The input method differs according to the NC being used, so refer to each NC Instruction Manual.
When setting the initial setting parameters, perform the following settings.

<For direct-drive motor system>

(1) Set the standard parameters in the section "7-1-2 List of standard parameters for each direct-drive motor".
(2) "7-1-1 Setting of detector related parameter"

⚠CAUTION **Do not release the emergency stop even after setting the above initial parameters. The initial setup (refer to the section "7-2 Initial setup for the direct-drive motor system") is always required to enable the test operation for the direct-drive motor (Ex. manual pulse feed, low-speed JOG feed).**

7-1-1 Setting of detector related parameters

Set the detector related parameters below depending on the detector connected.
#2219(SV019), #2220(SV020), #2317(SV117), #2318(SV118)

Mitsubishi serial signal output detector (Absolute position)

Manufacturer	Detector type	Interface unit type	Control resolution	#2219 (SV019)	#2220 (SV020)	#2317 (SV117)	#2318 (SV118)
Mitsubishi Electric	MBA405W	Provided	4,000,000p/rev	4000		0	
Magnescale	RU77	Not required	8,000,000p/rev	8000		0	
			32,000,000p/rev	32000		0	
HEIDENHAIN	RCN223M RCN723M	Not required	8,000,000p/rev	8000		0	
	RCN227M	Not required	134,217,728p/rev	0		2048	
	RCN727M RCN827M	Not required	134,217,728p/rev	0		2048	
MHI MACHINE TOOL ENGINEERING	MPRZ Series	ADB-20J71	8,000,000p/rev	8000		0	

【#2219(PR)】 SV019 RNG1 Sub side detector resolution

Set the number of pulses per revolution in one "kp" increments.

Note that the value must be input in increments of 10K pulses (the 1st digit of the setting value is "0").
If any restriction is imposed due to the above condition, also set SV117 in one pulse increments.

【#2220(PR)】 SV020 RNG2 Main side detector resolution

Set the same value as SV019.

【#2317(PR)】 SV117 RNG1ex Expansion sub side detector resolution

To set the resolution of the motor side detector in one pulse increments, set the number of pulses of the detector by 4-byte data in total to SV117 (high-order 16bit) and SV019 (low-order 16bit).

SV117= Quotient of the number of pulses divided by 65536 (If the quotient is 0, set SV117 to -1).
SV019= Remainder of the number of pulses divided by 65536
(SV019 can be set in one pulse increments).

If the NC is C70 and SV019 is greater than 32767, enter the (negative) value obtained by subtracting 65536 from the above remainder in SV019.

【#2318(PR)】 SV118 RNG2ex Expansion main side detector resolution

Set the same value as SV117.

7-1-2 List of standard parameters for each direct-drive motor

(1) Direct-drive motor TM-RB Series (MDS-D2-V□)

Parameter			Motor	Direct-drive motor TM-RB Series							
				012C20	036E20	048G20	105G10	105G20	150G20	340J20	500J20
No.	Abbrev.	Details	MDS-D2-V1-	40	80	80	160	160	160	320	320W
SV001	PC1	Motor side gear ratio		-	-	-	-	-	-	-	-
SV002	PC2	Machine side gear ratio		-	-	-	-	-	-	-	-
SV003	PGN1	Position loop gain 1		33	33	33	33	33	33	33	33
SV004	PGN2	Position loop gain 2		0	0	0	0	0	0	0	0
SV005	VGN1	Speed loop gain 1		100	100	100	100	100	100	100	100
SV006	VGN2	Speed loop gain 2		0	0	0	0	0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0	0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364	1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		20480	20480	20480	20480	20480	20480	20480	20480
SV010	IDA	Current loop d axis lead compensation		20480	20480	20480	20480	20480	20480	20480	20480
SV011	IQG	Current loop q axis gain		2048	2048	3072	6144	4096	3072	3072	2048
SV012	IDG	Current loop d axis gain		2048	2048	3072	6144	4096	3072	3072	2048
SV013	ILMT	Current limit value		800	800	800	800	800	800	800	800
SV014	ILMTsp	Current limit value in special control		800	800	800	800	800	800	800	800
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0	0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0	0	0	0	0
SV017	SPEC1	Servo specification 1		7000	7000	7000	7000	7000	7000	7000	7000
SV018	PIT	Ball screw pitch/Magnetic pole pitch		360	360	360	360	360	360	360	360
SV019	RNG1	Sub side detector resolution		-	-	-	-	-	-	-	-
SV020	RNG2	Main side detector resolution		-	-	-	-	-	-	-	-
SV021	OLT	Overload detection time constant		60	60	60	60	60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150	150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6	6	6	6	6
SV024	INP	In-position detection width		50	50	50	50	50	50	50	50
SV025	MTYP	Motor/Detector type		22FF	2213	22FF	22FF	22FF	2218	22FF	22FF
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6	6	6	6	6
SV027	SSF1	Servo function 1		4000	4000	4000	4000	4000	4000	4000	4000
SV028	MSFT	Magnetic pole shift amount		0	0	0	0	0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0	0	0	0	0
SV030	IVC	Voltage non-sensitive band compensation		0	0	0	0	0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0	0	0	0	0
SV032	TOF	Torque offset		0	0	0	0	0	0	0	0
SV033	SSF2	Servo function 2		0000	0000	0000	0000	0000	0000	0000	0000
SV034	SSF3	Servo function 3		0000	0000	0000	0000	0000	0000	0000	0000
SV035	SSF4	Servo function 4		0000	0000	0000	0000	0000	0000	0000	0000
SV036	PTYP	Power supply type/ Regenerative resistor type		0000	0000	0000	0000	0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0	0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0	0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0	0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band		0	0	0	0	0	0	0	0
SV041	LMC2	Lost motion compensation 2		0	0	0	0	0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0	0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0	0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0	0	0	0	0
SV045	TRUB	Friction torque		0	0	0	0	0	0	0	0
SV046	FHz2	Notch filter frequency 2		0	0	0	0	0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100	100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0	0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15	15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0	0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0	0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0	0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0	0	0	0	0
SV054	ORE	Overrun detection width in closed loop control		0	0	0	0	0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0	0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0	0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0	0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0	0	0	0	0
SV059	TCNV	Collision detection torque estimated gain		0	0	0	0	0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0	0	0	0	0
SV061	DA1NO	D/A output ch1 data No. for initial DC excitation level		0	0	0	0	0	0	0	0
SV062	DA2NO	D/A output ch2 data No. for final DC excitation level		0	0	0	0	0	0	0	0
SV063	DA1MPY	D/A output ch1 output scale for initial DC excitation time		0	0	0	0	0	0	0	0
SV064	DA2MPY	D/A output ch2 output scale		0	0	0	0	0	0	0	0
SV065	TLC	Machine end compensation gain		0	0	0	0	0	0	0	0

Parameter			Motor	Direct-drive motor TM-RB Series							
				012C20	036E20	048G20	105G10	105G20	150G20	340J20	500J20
No.	Abbrev.	Details	MDS-D2-V1-	40	80	80	160	160	160	320	320W
		(System parameter area)									
SV073	FEEDout	Specified speed output speed		0	0	0	0	0	0	0	0
		(System parameter area)									
SV081	SPEC2	Servo specification 2		0200	0200	0200	0200	0200	0200	0200	0200
SV082	SSF5	Servo function 5		0000	0000	0000	0000	0000	0000	0000	0000
SV083	SSF6	Servo function 6		0000	0000	0000	0000	0000	0000	0000	0000
SV084	SSF7	Servo function 7		0000	0000	0000	0000	0000	0000	0000	0000
SV085	LMCk	Lost motion compensation 3 spring constant		0	0	0	0	0	0	0	0
SV086	LMCc	Lost motion compensation 3 viscous coefficient		0	0	0	0	0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0	0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0	0	0	0	0
SV089				0	0	0	0	0	0	0	0
SV090				0	0	0	0	0	0	0	0
SV091	LMC4G	Lost motion compensation 4 gain		0	0	0	0	0	0	0	0
SV092				0	0	0	0	0	0	0	0
SV093				0	0	0	0	0	0	0	0
SV094	MPV	Magnetic pole position error detection speed		10	10	10	10	10	10	10	10
SV095	ZUPD	Vertical axis pull up distance		0	0	0	0	0	0	0	0
SV096				0	0	0	0	0	0	0	0
SV097				0	0	0	0	0	0	0	0
SV098				0	0	0	0	0	0	0	0
SV099				0	0	0	0	0	0	0	0
SV100				0	0	0	0	0	0	0	0
SV101				0	0	0	0	0	0	0	0
:				:	:	:	:	:	:	:	:
SV160				0	0	0	0	0	0	0	0
SV161	POLE	Motor unique constants		20	0	30	30	30	0	40	40
SV162	IS	Motor unique constants		-6102	0	-1211	-2101	-2671	0	-5381	-8211
SV163	IP	Motor unique constants		-1831	0	-3631	-5201	-6671	0	1340	2100
SV164	NR	Motor unique constants		5000	0	5000	2500	5000	0	4000	4000
SV165	JM	Motor unique constants		-2201	0	2800	3950	3930	0	2771	3531
SV166	RDQ	Motor unique constants		-3462	0	-1032	-9103	-6243	0	-2303	-1653
SV167	LQ	Motor unique constants		-5025	0	-3875	-3625	-2395	0	-1195	-8166
SV168	LD	Motor unique constants		0	0	0	0	0	0	0	0
SV169	KE	Motor unique constants		-6864	0	-1493	-1813	-1453	0	-2463	-2323
SV170	KT	Motor unique constants		-1962	0	-4282	-5112	-4152	0	-6912	-6632
SV171	OLT3	Motor unique constants		-4001	0	-4001	-4001	-4001	0	-4001	-4001
SV172				0	0	0	0	0	0	0	0
:				:	:	:	:	:	:	:	:
SV176				0	0	0	0	0	0	0	0
SV177	ATYP	Motor unique constants		400	0	800	1600	1600	0	3200	3201
SV178				0	0	0	0	0	0	0	0
SV179				0	0	0	0	0	0	0	0
SV180				0	0	0	0	0	0	0	0
SV181				0	0	0	0	0	0	0	0
SV182				0	0	0	0	0	0	0	0
SV183				0	0	0	0	0	0	0	0
SV184				0	0	0	0	0	0	0	0
:				:	:	:	:	:	:	:	:
SV256				0	0	0	0	0	0	0	0

(Note) When using a motor for which SV025 is set to 22FF, the motor name displayed by selecting [Servo unit] on the drive monitor screen will be "ROTmotor".

(2) Direct-drive motor TM-RB Series (MDS-DJ-V1)

Parameter			Motor	Direct-drive motor TM-RB Series			
				012C20	036E20	048G20	105G10
No.	Abbrev.	Details	MDS-DJ-V1-	40	80	80	100
SV001	PC1	Motor side gear ratio		-	-	-	-
SV002	PC2	Machine side gear ratio		-	-	-	-
SV003	PGN1	Position loop gain 1		33	33	33	33
SV004	PGN2	Position loop gain 2		0	0	0	0
SV005	VGN1	Speed loop gain 1		100	100	100	100
SV006	VGN2	Speed loop gain 2		0	0	0	0
SV007	VIL	Speed loop delay compensation		0	0	0	0
SV008	VIA	Speed loop lead compensation		1364	1364	1364	1364
SV009	IQA	Current loop q axis lead compensation		20480	20480	20480	20480
SV010	IDA	Current loop d axis lead compensation		20480	20480	20480	20480
SV011	IQG	Current loop q axis gain		3072	2560	4096	4096
SV012	IDG	Current loop d axis gain		3072	2560	4096	4096
SV013	ILMT	Current limit value		800	800	800	800
SV014	ILMTsp	Current limit value in special control		800	800	800	800
SV015	FFC	Acceleration rate feed forward gain		0	0	0	0
SV016	LMC1	Lost motion compensation 1		0	0	0	0
SV017	SPEC1	Servo specification 1		7000	7000	7000	7000
SV018	PIT	Ball screw pitch/Magnetic pole pitch		360	360	360	360
SV019	RNG1	Sub side detector resolution		-	-	-	-
SV020	RNG2	Main side detector resolution		-	-	-	-
SV021	OLT	Overload detection time constant		60	60	60	60
SV022	OLL	Overload detection level		150	150	150	150
SV023	OD1	Excessive error detection width during servo ON		6	6	6	6
SV024	INP	In-position detection width		50	50	50	50
SV025	MTYP	Motor/Detector type		22FF	2213	22FF	22FF
SV026	OD2	Excessive error detection width during servo OFF		6	6	6	6
SV027	SSF1	Servo function 1		4000	4000	4000	4000
SV028	MSFT	Magnetic pole shift amount		0	0	0	0
SV029	VCS	Speed at the change of speed loop gain		0	0	0	0
SV030	IVC	Voltage non-sensitive band compensation		0	0	0	0
SV031	OVS1	Overshooting compensation 1		0	0	0	0
SV032	TOF	Torque offset		0	0	0	0
SV033	SSF2	Servo function 2		0000	0000	0000	0000
SV034	SSF3	Servo function 3		0000	0000	0000	0000
SV035	SSF4	Servo function 4		0000	0000	0000	0000
SV036	PTYP	Power supply type/ Regenerative resistor type		0000	0000	0000	0000
SV037	JL	Load inertia scale		0	0	0	0
SV038	FHz1	Notch filter frequency 1		0	0	0	0
SV039	LMCD	Lost motion compensation timing		0	0	0	0
SV040	LMCT	Lost motion compensation non-sensitive band		0	0	0	0
SV041	LMC2	Lost motion compensation 2		0	0	0	0
SV042	OVS2	Overshooting compensation 2		0	0	0	0
SV043	OBS1	Disturbance observer filter frequency		0	0	0	0
SV044	OBS2	Disturbance observer gain		0	0	0	0
SV045	TRUB	Friction torque		0	0	0	0
SV046	FHz2	Notch filter frequency 2		0	0	0	0
SV047	EC	Inductive voltage compensation gain		100	100	100	100
SV048	EMGrt	Vertical axis drop prevention time		0	0	0	0
SV049	PGN1sp	Position loop gain 1 in spindle synchronous control		15	15	15	15
SV050	PGN2sp	Position loop gain 2 in spindle synchronous control		0	0	0	0
SV051	DFBT	Dual feedback control time constant		0	0	0	0
SV052	DFBN	Dual feedback control non-sensitive band		0	0	0	0
SV053	OD3	Excessive error detection width in special control		0	0	0	0
SV054	ORE	Overrun detection width in closed loop control		0	0	0	0
SV055	EMGx	Max. gate off delay time after emergency stop		0	0	0	0
SV056	EMGt	Deceleration time constant at emergency stop		0	0	0	0
SV057	SHGC	SHG control gain		0	0	0	0
SV058	SHGCsp	SHG control gain in spindle synchronous control		0	0	0	0
SV059	TCNV	Collision detection torque estimated gain		0	0	0	0
SV060	TLMT	Collision detection level		0	0	0	0
SV061	DA1NO	D/A output ch1 data No. for initial DC excitation level		0	0	0	0
SV062	DA2NO	D/A output ch2 data No. for final DC excitation level		0	0	0	0
SV063	DA1MPY	D/A output ch1 output scale for initial DC excitation time		0	0	0	0
SV064	DA2MPY	D/A output ch2 output scale		0	0	0	0
SV065	TLC	Machine end compensation gain		0	0	0	0

Parameter			Motor	Direct-drive motor TM-RB Series			
				012C20	036E20	048G20	105G10
No.	Abbrev.	Details	MDS-DJ-V1-	40	80	80	100
		(System parameter area)					
SV073	FEEDout	Specified speed output speed		0	0	0	0
		(System parameter area)					
SV081	SPEC2	Servo specification 2		0000	0000	0000	0000
SV082	SSF5	Servo function 5		0000	0000	0000	0000
SV083	SSF6	Servo function 6		0000	0000	0000	0000
SV084	SSF7	Servo function 7		0000	0000	0000	0000
SV085	LMCk	Lost motion compensation 3 spring constant		0	0	0	0
SV086	LMCc	Lost motion compensation 3 viscous coefficient		0	0	0	0
SV087	FHz4	Notch filter frequency 4		0	0	0	0
SV088	FHz5	Notch filter frequency 5		0	0	0	0
SV089				0	0	0	0
SV090				0	0	0	0
SV091	LMC4G	Lost motion compensation 4 gain		0	0	0	0
SV092				0	0	0	0
SV093				0	0	0	0
SV094	MPV	Magnetic pole position error detection speed		10	10	10	10
SV095	ZUPD	Vertical axis pull up distance		0	0	0	0
SV096				0	0	0	0
SV097				0	0	0	0
SV098				0	0	0	0
SV099				0	0	0	0
SV100				0	0	0	0
SV101				0	0	0	0
:				:	:	:	:
SV160				0	0	0	0
SV161	POLE	Motor unique constants		20	0	30	30
SV162	IS	Motor unique constants		-6102	0	-1211	-2101
SV163	IP	Motor unique constants		-1831	0	-3631	-5201
SV164	NR	Motor unique constants		5000	0	5000	2500
SV165	JM	Motor unique constants		-2201	0	2800	3950
SV166	RDQ	Motor unique constants		-3462	0	-1032	-9103
SV167	LQ	Motor unique constants		-5025	0	-3875	-3625
SV168	LD	Motor unique constants		0	0	0	0
SV169	KE	Motor unique constants		-6864	0	-1493	-1813
SV170	KT	Motor unique constants		-1962	0	-4282	-5112
SV171	OLT3	Motor unique constants		-4001	0	-4001	-4001
SV172				0	0	0	0
:				:	:	:	:
SV176				0	0	0	0
SV177	ATYP	Motor unique constants		100	0	200	350
SV178				0	0	0	0
SV179				0	0	0	0
SV180				0	0	0	0
SV181				0	0	0	0
SV182				0	0	0	0
SV183				0	0	0	0
SV184				0	0	0	0
:				:	:	:	:
SV256				0	0	0	0

(Note) When using a motor for which SV025 is set to 22FF, the motor name displayed by selecting [Servo unit] on the drive monitor screen will be "ROTmotor".

7-2 Initial setup for the direct-drive motor system

This section explains the initial setup procedures for direct-drive motor.

⚠CAUTION

1. Perform the initial setup after the operation is enabled for NC system.

2. The initial setup is required for each direct-drive motor.

3. Perform the initial setup again after replacing the detector.

4. For a system with multiple direct-drive motor axes, the initial setup (DC excitation function) must be performed for each axis. Set #2213(SV013) to 0 and #2228(SV028) to 1 for the direct-drive motor axis for which the DC excitation function is not enabled. If the emergency stop is released in the state of #2228(SV028) is 0, magnetic pole position detection error (16) will occur.

5. The initial setup method differs when using MBA405W. Refer to "Initial setup for the direct-drive motor system when using MBA405W".

7-2-1 Adjustment procedure

For the direct-drive motor system, the initial setup must be performed for each machine because the position relation between the motor coil and detector differs among machines. Be sure to set up according to the following procedures. The motor may not work properly unless the initial setup for the magnetic pole (DC excitation function) is performed correctly.
DC excitation function detects the position relation (magnetic pole shift amount) between the motor coil and detector. The magnetic pole shift amount can be seen at [AFLT gain] on the NC's servo diagnosis screen by moving the direct-drive motor with DC excitation function. The motor will be driven according to the magnetic pole shift amount from next time the NC power is turned ON.
With the DC excitation function, once the servo parameter (SV028) is set, resetting is not required unless the detector is replaced.

<DC excitation function>

(1) Turn ON the servo drive unit and NC. Confirm that there is no error such as Initial parameter error (37).
(2) Set the servo parameter #2213(SV013) to 100.
(3) Set the parameters related to the DC excitation function (#2261(SV061) to 10, #2262(SV062) to 10, and #2263(SV063) to 1000).
(4) Set the servo parameter #2234/bit4(SV034/bit4) to "1" to enable the DC excitation mode.
(5) Release the emergency stop.
(6) Confirm that the direct-drive motor carries out a reciprocation operation between about ±10° and 20° once (start DC excitation).
(7) Confirm that the direct-drive motor stops after the reciprocation operation.
(8) Switch to the [Servo diagn] menu on the NC maintenance screen, select [Servo unit] and monitor [AFLT gain].
(9) Turn ON the emergency stop (terminate DC excitation).
(10) Repeat (5) to (9) 5 times, and monitor the ALFT gain value (magnetic pole shift amount) each time.
If difference of the magnetic pole shift amounts is 1000 data or bigger, reset the related parameter settings (#2261(SV061)=+10, #2262(SV062)=+10) and perform (5) to (9) again.
(11) Calculate the average of the magnetic pole shift amounts, and set it to #2228(SV028).
(12) Return the servo parameter #2234/bit4(SV034/bit4) back to the original setting, "0".
(13) Turn the NC power ON again.

<Confirmation of detector installation polarity>

(14) Release the emergency stop.
(15) Drive the direct-drive motor about ±20° with handle feed (select the minimum pulse magnification).
(16) Switch to the [Servo diagn] menu on the NC maintenance screen, select [Servo unit] and check [Load current]. Also check if any alarm is occurring.
-> The detector installation polarity may be reverse if the current value reaches to the current limit or any alarm occurs. Set the servo parameter #2217/bit0(SV017/bit0) to "1" and perform (14) to (16) again after turning the NC power ON again.
(17) Turn ON the emergency stop.
(18) Return the servo parameter #2213(SV013) back to the original setting after confirming the initial setup.

⚠ CAUTION

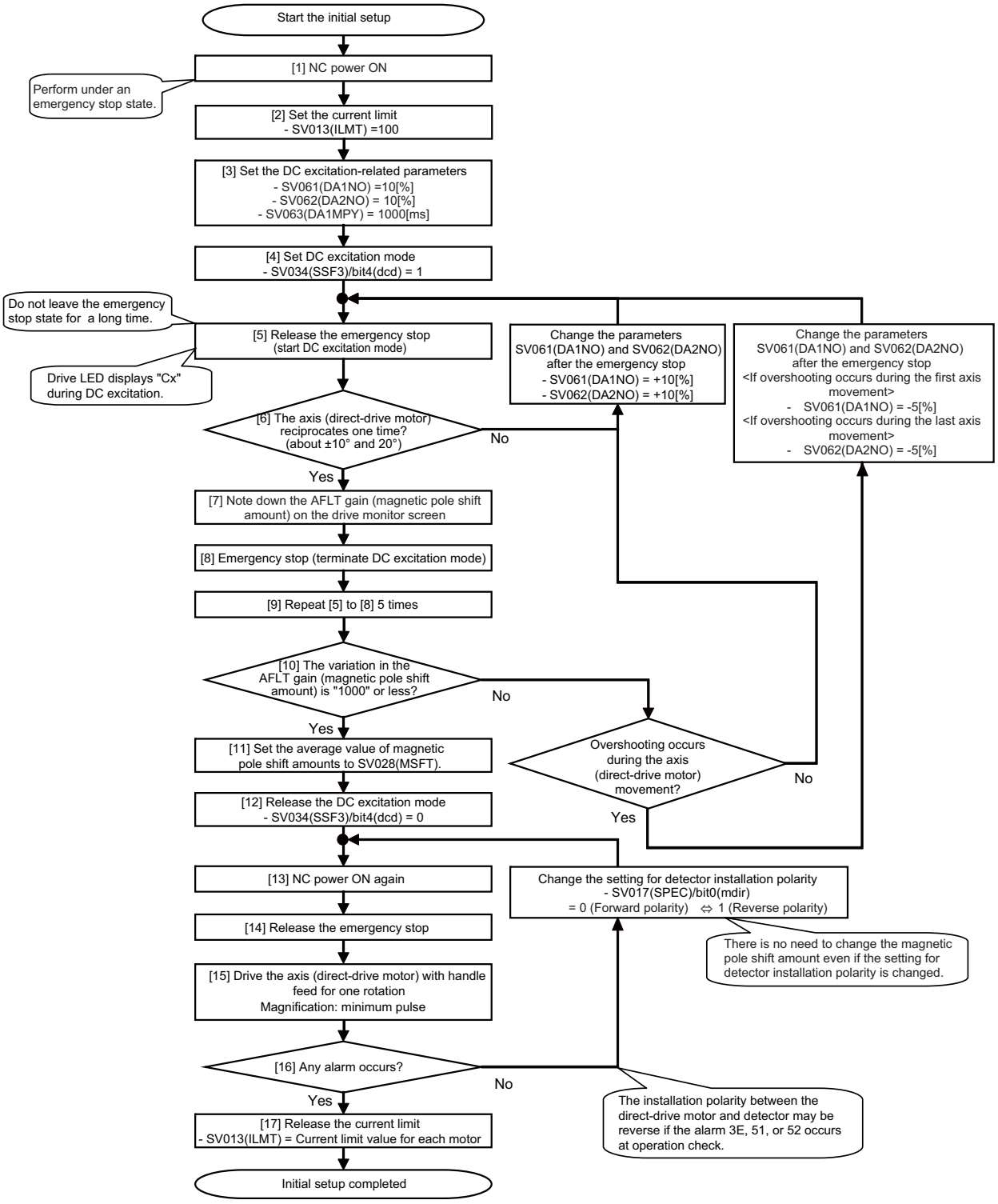
1. Never operate the direct-drive motor before DC excitation function is enabled.

2. The motor carries out a reciprocation operation at about the magnetic pole pitch while DC excitation function is enabled.

3. The magnetic pole shift amount cannot be calculated correctly with incorrect wiring in the motor power line or detector cable.

Initial setup procedures for direct-drive motor (DC excitation function)

Perform the initial setup for the direct-drive motor by following the steps in the flow diagram below.


Start the initial setup
[1] NC power ON
Perform under an emergency stop state.
[2] Set the current limit
- SV013(ILMT) =100
[3] Set the DC excitation-related parameters
- SV061(DA1NO) =10[%]
- SV062(DA2NO) = 10[%]
- SV063(DA1MPY) = 1000[ms]
[4] Set DC excitation mode
- SV034(SSF3)/bit4(dcd) = 1
Do not leave the emergency stop state for a long time.
[5] Release the emergency stop (start DC excitation mode)
Drive LED displays "Cx" during DC excitation.
Change the parameters SV061(DA1NO) and SV062(DA2NO) after the emergency stop
- SV061(DA1NO) = +10[%]
- SV062(DA2NO) = +10[%]
Change the parameters SV061(DA1NO) and SV062(DA2NO) after the emergency stop
<If overshooting occurs during the first axis movement>
- SV061(DA1NO) = -5[%]
<If overshooting occurs during the last axis movement>
- SV062(DA2NO) = -5[%]
[6] The axis (direct-drive motor) reciprocates one time? (about ±10° and 20°)
No
Yes
[7] Note down the AFLT gain (magnetic pole shift amount) on the drive monitor screen
[8] Emergency stop (terminate DC excitation mode)
[9] Repeat [5] to [8] 5 times
[10] The variation in the AFLT gain (magnetic pole shift amount) is "1000" or less?
No
Yes
Overshooting occurs during the axis (direct-drive motor) movement?
No
Yes
[11] Set the average value of magnetic pole shift amounts to SV028(MSFT).
[12] Release the DC excitation mode
- SV034(SSF3)/bit4(dcd) = 0
[13] NC power ON again
Change the setting for detector installation polarity
- SV017(SPEC)/bit0(mdir)
= 0 (Forward polarity) ⇔ 1 (Reverse polarity)
There is no need to change the magnetic pole shift amount even if the setting for detector installation polarity is changed.
[14] Release the emergency stop
[15] Drive the axis (direct-drive motor) with handle feed for one rotation
Magnification: minimum pulse
[16] Any alarm occurs?
No
Yes
The installation polarity between the direct-drive motor and detector may be reverse if the alarm 3E, 51, or 52 occurs at operation check.
[17] Release the current limit
- SV013(ILMT) = Current limit value for each motor
Initial setup completed

7-2-2 Related parameters

As DC excitation is a function used for initial setup for the direct-drive motor, use the servo parameters #2261(SV061) and #2262(SV062) that have another function (D/A output) used for adjustment.
Note, however, that these parameters are enabled as the DC excitation function parameters when the servo parameter #2234/bit4(SV034/bit4) is set to "1".

【#2217(PR)】 SV017 SPEC1 Servo specification 1

bit 0 : mdir Main side detector feedback (for direct-drive motor)

Set the detector installation polarity in the direct-drive motor control.

0: Forward polarity 1: Reverse polarity

【#2228(PR)】 SV028 MSFT Magnetic pole shift amount (for direct-drive motor)

Set this parameter to adjust the motor magnetic pole position and detector's installation phase when using direct-drive motors.
During the DC excitation of the initial setup (SV034/bit4=1), set the same value displayed in "AFLT gain" on the NC monitor screen.

Related parameters: SV034/bit4, SV061, SV062, SV063

---Setting range---
-18000 to 18000 (Mechanical angle 0.01°)

【#2234】 SV034 SSF3 Servo function 3

bit 4 : dcd (direct-drive motor)

0: Normal setting 1: DC excitation mode

Related parameters: SV061, SV062, SV063

【#2261】 SV061 DA1NO D/A output ch1 data No. / Initial DC excitation level

Input the data number you wish to output to the D/A output channel 1.
When using the multi-axis drive unit, set "-1" to the axis that the data will not be output.

When the DC excitation is running (SV034/bit4=1):
Use this when the DC excitation is running (SV034/bit4=1) to adjust the initial setup (when measuring the magnetic pole shift amount) for direct-drive motor.
Set the initial excitation level in DC excitation control.
Set 10% as standard.

Related parameters: SV034/bit4,SV062, SV063

---Setting range---
-1 to 127
When the DC excitation is running (SV034/bit4=1): 0 to 100 (Stall current %)

【#2262】 SV062 DA2NO D/A output ch2 data No. / Final DC excitation level

Input the data number you wish to output to the D/A output channel 2.
When using the multi-axis drive unit, set "-1" to the axis that the data will not be output.

When the DC excitation is running (SV034/bit4=1):
Use this when the DC excitation is running (SV034/bit4=1) to adjust the initial setup (when measuring the magnetic pole shift amount) for direct-drive motor.
Set the final excitation level in DC excitation control.
Set 10% as standard.

Related parameters: SV034/bit4,SV061, SV063

---Setting range---
-1 to 127
When the DC excitation is running (SV034/bit4=1): 0 to 100 (Stall current %)

【#2263】 SV063 DA1MPY D/A output ch1 output scale / Initial DC excitation time

Set output scale of the D/A output channel 1 in increment of 1/100.
When "0" is set, the magnification is the same as when "100" is set.

When the DC excitation is running (SV034/bit4=1):
Use this when the DC excitation is running (SV034/bit4=1) to adjust the initial setup (when measuring the magnetic pole shift amount) for direct-drive motor.
Set the initial excitation time in DC excitation control.
Set 1000ms as standard.

Related parameters: SV034/bit4,SV061, SV062

---Setting range---
-32768 to 32767 (1/100-fold)
When the DC excitation is running (SV034/bit4=1): 0 to 10000 (ms)

7-3 Initial setup for direct-drive motor system when using MBA405W

This section explains the initial setup procedures when using MBA405W.

⚠CAUTION

1. Perform the initial setup after the operation is enabled for NC system.

2. The initial setup is required for each direct-drive motor.

3. Perform the initial setup again after replacing the detector.

4. For the initial setup, the main head of MBA405W is required to detect Z-phase signal (Z-phase signal position mark needs to pass the main head). If the structure does not allow the magnetic drum to turn move than one revolution, reinstall it so that Z-phase passes the main head within the shaft stroke.

7-3-1 Adjustment procedure

Although MBA405W is an absolute position detector, it needs to pass Z-phase at the initial power ON before the initial setup (DC excitation) is carried out.
Therefore, when using it with a direct-drive motor, drive the motor until the detector passes the Z-phase by initial magnetic pole estimate. After the Z-phase has been passed, turn the NC power ON again to decide the absolute position within one revolution.
After deciding the absolute position, execute the DC excitation function in the same manner as for the other absolute detectors to decide the magnetic pole shift amount.

<Initial magnetic pole estimate function>

(1) Set the incremental control (#2049 type to 0).
(2) Set the parameters related to the initial magnetic pole estimate function (#2321(SV121) to 33, #2322(SV122) to Standard VGN1, and #2323(SV123) to 1364).
-> Standard VGN1 is set depending on the load inertia scale for #2322(SV122). (Refer to "8-1-1 Speed loop gain".)
(3) Turn the NC power ON again.
-> Confirm that the warning during initial setup for the absolute position (A3) occurs.
-> Select the [Servo diagn] and [Servo unit] menus on the NC maintenance screen, and confirm that [Motor end detector] displays "MB*405W".
(4) Release the emergency stop.
(5) The LED on the drive unit changes to "Cx" and the direct-drive motor moves by little and little for about five seconds (start initial magnetic pole estimate).
(6) Confirm that the LED on the drive unit changes to "dx" and the motor stops (terminate initial magnetic pole estimate).

<Confirmation of detector installation polarity>

(7) Drive the direct-drive motor until the Z-phase has been detected with handle feed (select the minimum pulse magnification).
   -> Switch to the [Servo diagn] menu on the NC maintenance screen, select [Servo unit] and confirm [Control output 2/bit0(ZCN) *Z-phase passed] is "1".

(8) Switch to the [Servo diagn] menu on the NC maintenance screen, select [Servo unit] and check [Load current]. Also check if any alarm is occurring.
   -> The detector installation polarity may be reverse if the current value reaches to the current limit or any alarm occurs. Set the servo parameter #2217/bit0(SV017/bit0) to "1" and perform (4) to (8) again after turning the NC power ON again.

(9) Turn ON the emergency stop.

(10) Set the parameter (NC system side) for enabling the absolute position control (#2049(type) = the absolute position zero point alignment method to be used) .

(11) Release the parameters related to the initial magnetic pole estimate function (#2321(SV121) to 0, #2322(SV122) to 0, and #2323(SV123) to 0).

(12) Turn the NC power ON again.

(13) Confirm that the warning during initial setup for the absolute position (A3) is released and [Motor end detector] displays "MBA405W".

<DC excitation function>

(14) Set the servo parameter #2213(SV013) to 100.

(15) Set the parameters related to the DC excitation (#2261(SV061) to 10, #2262(SV062) to 10, and #2263(SV063) to 1000).

(16) Set the servo parameter #2234/bit4(SV034/bit4) to "1" to enable the DC excitation mode.

(17) Release the emergency stop.

(18) Confirm that the direct-drive motor carries out a reciprocation operation between about ±10° and 20°once (start DC excitation).

(19) Confirm that the direct-drive motor stops after the reciprocation operation.

(20) Switch to the [Servo diagn] menu on the NC maintenance screen, select [Servo unit] and monitor [AFLT gain].

(21) Turn ON the emergency stop (terminate DC excitation).

(22) Repeat (17) to (21) 5 times, and monitor the ALFT gain value (magnetic pole shift amount) each time.
If difference of the magnetic pole shift amounts is 1000 data or bigger, reset the related parameter settings (#2261(SV061)=+10, #2262(SV062)=+10) and perform (17) to (21) again.

(23) Calculate the average of the magnetic pole shift amounts, and set it to #2228(SV028).

(24) Return the servo parameter #2234/bit4(SV034/bit4) back to the original setting, "0".

(25) Turn the NC power ON again.

(26) Return the servo parameter #2213(SV013) back to the original setting after confirming the initial setup.

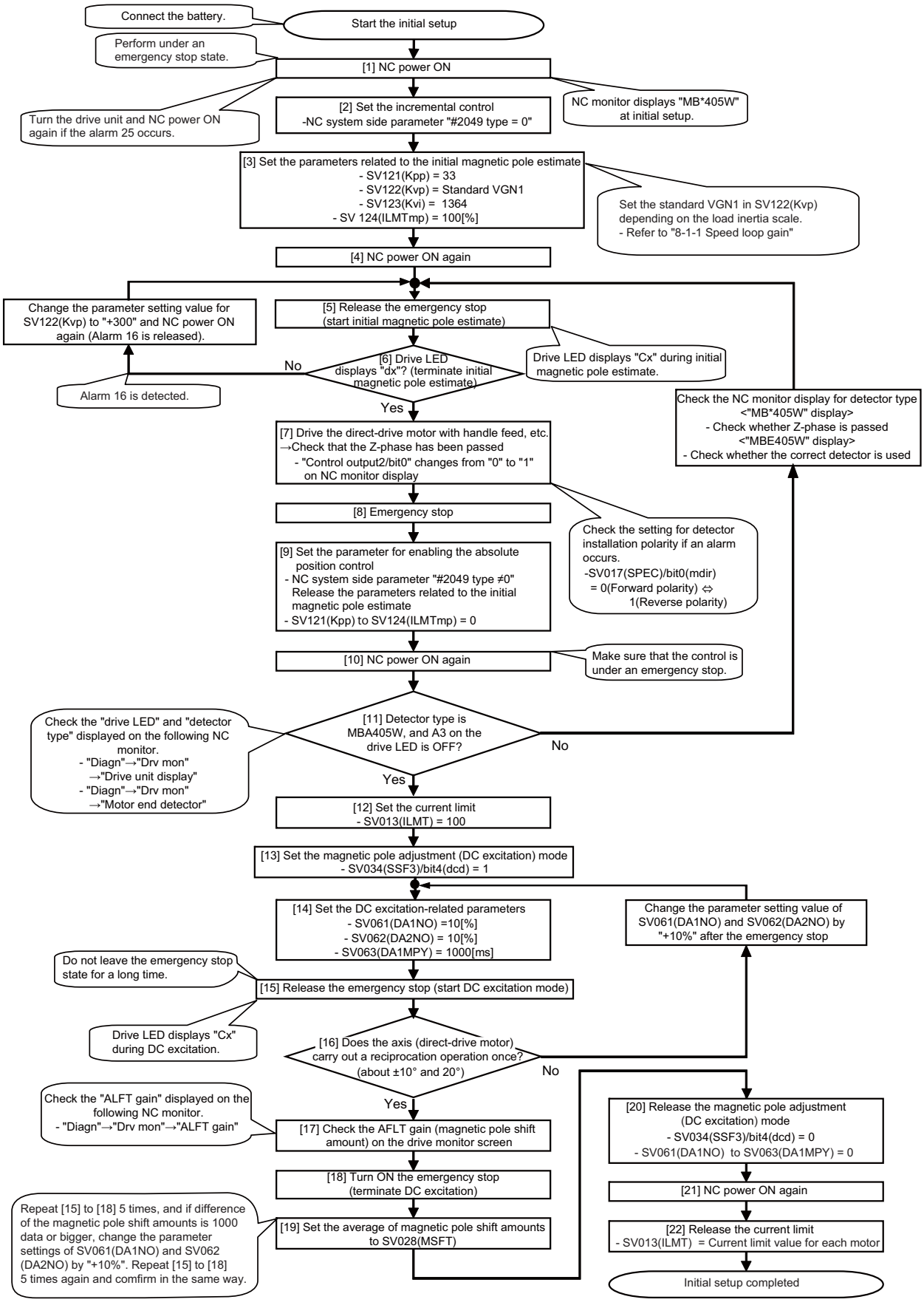
⚠ CAUTION

1. Alarm 37 / error number 2198 is detected before the initial setup operation, but this is not a fault. The alarm will be cleared after the initial setup is completed and by turning the NC power ON again.

2. The NC monitor displays "MB*405W" before the initial setup is completed. It will be correctly displayed as "MBA405W" after the initial setup is completed.

Initial setup procedures for direct-drive motor (when using MBA405W)

When using MBA405W, perform the initial setup for the direct-drive motor by following the steps in the flow diagram below.


Connect the battery.
Start the initial setup
Perform under an emergency stop state.
[1] NC power ON
Turn the drive unit and NC power ON again if the alarm 25 occurs.
[2] Set the incremental control -NC system side parameter "#2049 type = 0"
NC monitor displays "MB*405W" at initial setup.
[3] Set the parameters related to the initial magnetic pole estimate
- SV121(Kpp) = 33
- SV122(Kvp) = Standard VGN1
- SV123(Kvi) = 1364
- SV 124(ILMTmp) = 100[%]
Set the standard VGN1 in SV122(Kvp) depending on the load inertia scale.
- Refer to "8-1-1 Speed loop gain"
[4] NC power ON again
Change the parameter setting value for SV122(Kvp) to "+300" and NC power ON again (Alarm 16 is released).
[5] Release the emergency stop (start initial magnetic pole estimate)
No
[6] Drive LED displays "dx"? (terminate initial magnetic pole estimate)
Drive LED displays "Cx" during initial magnetic pole estimate.
Alarm 16 is detected.
Yes
Check the NC monitor display for detector type
<"MB*405W" display>
- Check whether Z-phase is passed
<"MBE405W" display>
- Check whether the correct detector is used
[7] Drive the direct-drive motor with handle feed, etc.
→Check that the Z-phase has been passed
- "Control output2/bit0" changes from "0" to "1" on NC monitor display
[8] Emergency stop
Check the setting for detector installation polarity if an alarm occurs.
-SV017(SPEC)/bit0(mdir)
= 0(Forward polarity) ⇔ 1(Reverse polarity)
[9] Set the parameter for enabling the absolute position control
- NC system side parameter "#2049 type ≠0"
Release the parameters related to the initial magnetic pole estimate
- SV121(Kpp) to SV124(ILMTmp) = 0
[10] NC power ON again
Make sure that the control is under an emergency stop.
Check the "drive LED" and "detector type" displayed on the following NC monitor.
- "Diagn"→"Drv mon" →"Drive unit display"
- "Diagn"→"Drv mon" →"Motor end detector"
[11] Detector type is MBA405W, and A3 on the drive LED is OFF?
No
Yes
[12] Set the current limit
- SV013(ILMT) = 100
[13] Set the magnetic pole adjustment (DC excitation) mode
- SV034(SSF3)/bit4(dcd) = 1
[14] Set the DC excitation-related parameters
- SV061(DA1NO) =10[%]
- SV062(DA2NO) = 10[%]
- SV063(DA1MPY) = 1000[ms]
Change the parameter setting value of SV061(DA1NO) and SV062(DA2NO) by "+10%" after the emergency stop
Do not leave the emergency stop state for a long time.
[15] Release the emergency stop (start DC excitation mode)
Drive LED displays "Cx" during DC excitation.
[16] Does the axis (direct-drive motor) carry out a reciprocation operation once? (about ±10° and 20°)
No
Yes
Check the "ALFT gain" displayed on the following NC monitor.
- "Diagn"→"Drv mon"→"ALFT gain"
[17] Check the AFLT gain (magnetic pole shift amount) on the drive monitor screen
[18] Turn ON the emergency stop (terminate DC excitation)
Repeat [15] to [18] 5 times, and if difference of the magnetic pole shift amounts is 1000 data or bigger, change the parameter settings of SV061(DA1NO) and SV062 (DA2NO) by "+10%". Repeat [15] to [18] 5 times again and comfirm in the same way.
[19] Set the average of magnetic pole shift amounts to SV028(MSFT)
[20] Release the magnetic pole adjustment (DC excitation) mode
- SV034(SSF3)/bit4(dcd) = 0
- SV061(DA1NO) to SV063(DA1MPY) = 0
[21] NC power ON again
[22] Release the current limit
- SV013(ILMT) = Current limit value for each motor
Initial setup completed

7-3-2 Related parameters

For the initial setup when using MBA405W, the following parameters are required to be set in addition to those related to the DC excitation function. If the initial setup for MBA405W is performed before setting these parameters, an alarm for Initial parameter error (37) occurs.

【#2321】SV121 Kpp Magnetic pole detection position loop gain

Set this parameter to adjust the motor magnetic pole position and detector's installation phase at using MBA405W.
Set the position loop gain in the magnetic polar detection loop at the initial magnetic polar detection.

The initial magnetic polar detection is performed for the direct-drive motor which uses MBA405W as the motor side detector.

Related parameters : SV122,SV123,SV124

--- Setting range---
0 to 32767

【#2322】 SV122 Kvp Magnetic pole detection speed loop gain

Set this parameter to adjust the motor magnetic pole position and detector's installation phase at initial setup when using MBA405W.
Set the speed loop gain in the magnetic polar detection loop at the initial magnetic polar detection.

The initial magnetic polar detection is performed for the direct-drive motor which uses MBA405W as the motor side detector.

Related parameters : SV121,SV123,SV124

--- Setting range---
0 to 32767

【#2323】 SV123 Kvi Magnetic pole detection speed loop lead compensation

Set this parameter to adjust the motor magnetic pole position and detector's installation phase at initial setup when using MBA405W.
Set the speed loop lead compensation in the magnetic polar detection loop at the initial magnetic polar detection.

The initial magnetic polar detection is performed for the direct-drive motor which uses MBA405W as the motor side detector.

Related parameters : SV121,SV122,SV124

--- Setting range---
0 to 32767

【#2324】SV124 ILMTmp Initial magnetic polar estimate/current limit value

Set this parameter to adjust the motor magnetic pole position and detector's installation phase at initial setup when using MBA405W.
Set the current (torque) limit value in the magnetic polar detection loop at the initial magnetic polar detection.

The initial magnetic polar detection is performed for the direct-drive motor which uses MBA405W as the motor side detector.
When set to "0", use SV014(ILMTsp) for the current limit at the initial magnetic polar estimate.

Related parameters : SV121,SV122,SV123

--- Setting range---
0 to 200
(Stall current %)

7-4 Protective functions list of units

The protective functions related to the direct-drive motor system are shown below.

7-4-1 Drive unit alarm

No.	Name	Details	Reset method	Stop method
16	Initial magnetic pole position detection error	-In the direct-drive motor which uses the absolute position detector, the servo ON has been set before the magnetic pole shift amount (SV028) is set. -The magnetic pole position, detected in the initial magnetic pole estimate function at initial setup when using MBA405W, is not correctly estimated.	PR	Dynamic stop
25	Absolute position data lost	-The absolute position data was lost in the detector.	AR	Initial error
37	Initial parameter error	-An incorrect set value was detected among the parameters send from the NC at the power ON.	PR	Initial error
3E	Magnetic pole position detection error	-The magnetic pole position, detected in the magnetic pole position detection control, is not correctly detected. The setting of magnetic pole shift amount (SV028) is not reliable.	AR	Dynamic stop
46	Motor overheat / Thermal error	- An overheat is detected on the motor. - The thermistor signal receiving circuit of the linear motor or direct-drive motor was disconnected. - The thermistor signal receiving circuit was short-circuited.	NR	Deceleration stop
51	Overload 2	- Current command of 95% or more of the unit's max. current was given continuously for 1 second or longer. - The detector installation polarity (SV17/bit0) may be reverse.	NR	Deceleration stop
52	Excessive error 1	-A position tracking error during servo ON was excessive.	NR	Deceleration stop

(Note 1)Resetting methods
NR : Reset with the NC RESET button. This alarm can also be reset with the PR and AR resetting conditions.
PR : Reset by turning the NC power ON again. This alarm can also be reset with the AR resetting conditions.
When the control axis is removed, this alarm can be reset with the NC RESET button. (Excluding alarms 32 and 37.)
AR : Reset by turning the servo drive unit power ON again.

Detector alarm (Servo drive unit)

Alarm number when the detector is connected to CN2 side		2B	2C	2D	2E	48	49	4A	4B
MBA405W	Mitsubishi Electric	CPU error	Waveform error	Data error	-	-	-	-	Count error
RCN223M, RCN227M, RCN727M, RCN827M	HEIDENHAIN	Initialization error	EEPROM error	Relative/ absolutepo sition data mismatch	ROM-RAM error	CPU error	Overspeed	Absolute position data error	Relative position data error
MPRZ scale	MHI	Installation accuracy fault	-	Detection position deviance	Scale breaking	Absolute value detection fault	-	Gain fault	Phase fault
RU77	Magnescale	Laser diode error	System memory error	Encoder mismatch error	-	-	Overspeed	Absolute position data error	Relative position data error

(Note) A drive unit processes all reset types of alarms as "PR". However, "AR" will be applied according to the detector.

7-4-2 Drive unit warning

No.	Name	Details	Reset method	Stop method
A3	Distance-coded reference check / initial setup warning	This warning is detected during the initial setup of MBA405W. This warning turns OFF after the initial setup is completed when the axis has passed the Z-phase of MBA405W and the NC power has been turned again.	PR	-
E4	Parameter warning	An incorrect set value was detected among the parameters send from the NC in the normal operation.	*	-

(Note 1)A drive unit processes all reset types of alarms as "PR". However, "AR" will be applied according to the detector.
(Note 2)Resetting methods
* : Automatically reset once the cause of the warning is removed.
NR : Reset with the NC RESET button. This warning can also be reset with the PR and AR resetting conditions.
PR : Reset by turning the NC power ON again. This warning can also be reset with the AR resetting conditions.
AR : Reset by turning the servo drive unit power ON again.
(Note 3)Direct-drive motor does not stop when the warning occurs.
(Note 4)When an emergency stop is input, direct-drive motor decelerates to a stop. (When SV048, SV055 or SV056 is set.)

7-4-3 Parameter numbers during initial parameter error

<Parameter error No.>

f an initial parameter error (alarm 37) or set parameter warning (warning E4) occurs, the axis name and the No. of the error parameter that exceeds the setting range will appear on the NC Diagnosis screen as shown below:

S02 Initial parameter error ○○○○□
○○○○ : Error parameter No.
□ : Axis name

S52 Parameter error warning ○○○○□
○○○○ : Error parameter No.
□ : Axis name

If an error No. in the following table is displayed as the error parameter No. even when the parameter is set to a value within the setting range, an error is occurring due to the hardware compatibility or specifications or in relation to several other parameters. Check the specifications and initial setup method of the direct-drive motor system, and correctly set the parameters according to the descriptions in the following table.

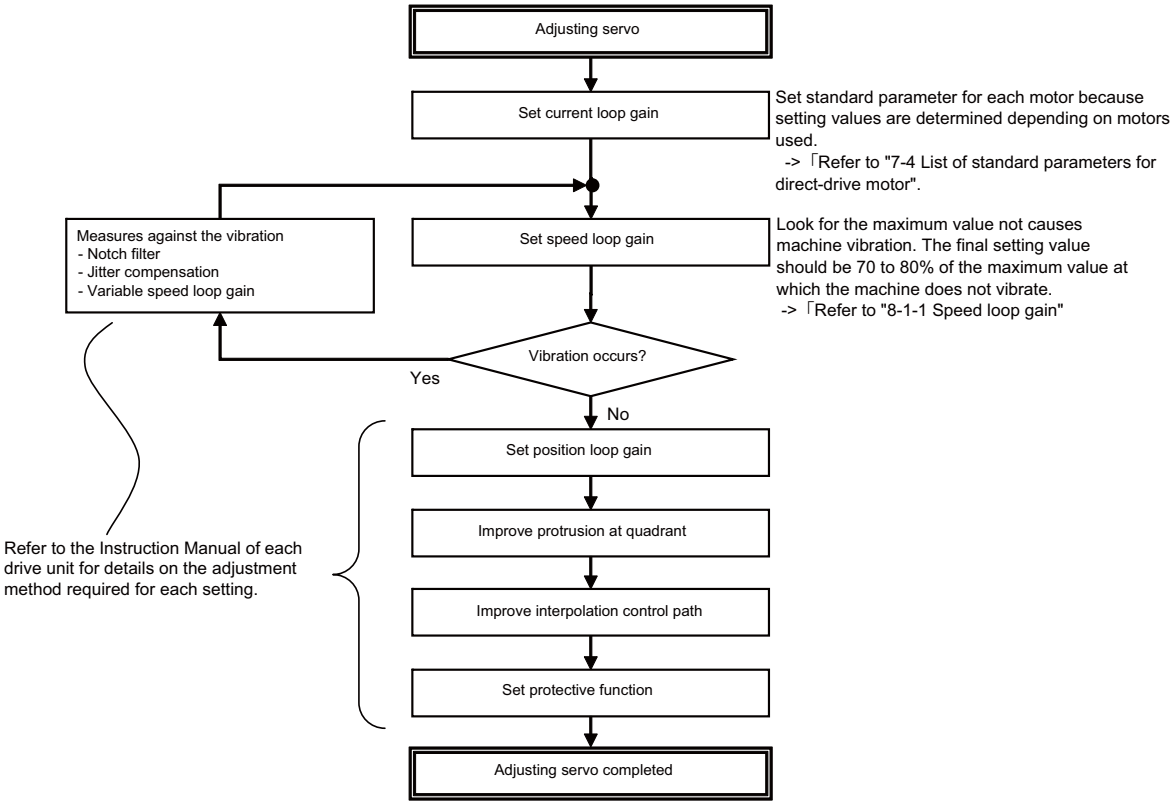
Error parameter No.	Details	Related parameters
2198	The parameter for enabling the absolute position control (#2049 type) is set before the initial setup is completed when MBA405W is connected.	#2049
2217	The motor selected is of a motor series different from the drive unit's input voltage (200V/400V). Or a motor of an incompatible motor series is selected.	SV017
2219	-In a semi-closed loop control system, the setting value of SV019 is different from that of SV020. Set them to the same value. -SV019 is set to a value outside the setting range.	SV019
2220	-The resolution of the motor side detector actually connected is not consistent with the setting value for SV020. -SV020 is set to a value outside the setting range.	SV020
2225	Incompatible motor type is selected. The machine side detector type or the motor side detector type is incorrectly set.	SV017, SV025
2228	The magnetic pole shift amount (SV028) is set for a general servo motor (not a built-in motor).	SV028
2234	The DC excitation mode (SV034/bit4) is set in the following conditions: -when the NC is powered ON -when a general servo motor (not a built-in motor) is used.	SV034
2261	When the DC excitation mode (SV034/bit4) is set, the initial DC excitation level (SV061) is set to a value outside the setting range.	SV034, SV061
2262	When the DC excitation mode (SV034/bit4) is set, the final DC excitation level (SV062) is set to a value outside the setting range.	SV034, SV062
2263	When the DC excitation mode (SV034/bit4) is set, the initial DC excitation time (SV063) is set to a value outside the setting range.	SV034, SV063
2317	-The expansion sub side detector resolution (SV117) is set to "0" for a detector that requires the resolution expansion setting. If the upper 16 bits for the detector resolution are 0, this should be set to "-1". -The expansion sub side detector resolution (SV117) is set to a value other than "0" for a detector that does not support the resolution expansion setting.	SV019,SV025,SV117
2318	-The expansion main side detector resolution (SV118) is set to "0" for a detector that requires the resolution expansion setting. If the upper 16 bits for the detector resolution are 0, this should be set to "-1". -The expansion main side detector resolution (SV118) is set to a value other than "0" for a detector that does not support the resolution expansion setting.	SV020,SV025,SV118
2321	Magnetic pole detection position loop gain (SV121) is not set at initial setup when MBA405W is connected.	SV121
2322	Magnetic pole detection speed loop gain (SV122) is not set at initial setup when MBA405W is connected.	SV122
2323	Magnetic pole detection speed loop lead compensation (SV123) is not set at initial setup when MBA405W is connected.	SV123

8

Servo Adjustment

8-1 Servo adjustment procedure

The servo parameters must be set before the direct-drive motor can be started up. The servo parameters are input from the NC. The input method differs according to the NC being used, so refer to each NC Instruction Manual.
When setting the initial setting parameters, perform the following settings.


Adjusting servo
Set current loop gain
Set standard parameter for each motor because setting values are determined depending on motors used.
-> 「Refer to "7-4 List of standard parameters for direct-drive motor".
Set speed loop gain
Look for the maximum value not causes machine vibration. The final setting value should be 70 to 80% of the maximum value at which the machine does not vibrate.
-> 「Refer to "8-1-1 Speed loop gain"
Measures against the vibration
- Notch filter
- Jitter compensation
- Variable speed loop gain
Vibration occurs?
Yes
No
Set position loop gain
Improve protrusion at quadrant
Improve interpolation control path
Set protective function
Adjusting servo completed
Refer to the Instruction Manual of each drive unit for details on the adjustment method required for each setting.

⚠ CAUTION Perform adjusting the servo in the factory configuration of the machine. When the servo is adjusted without having an enough running-in or a cover, friction force, machine resonance frequency or resonance gain may be different, resulting in an incorrect adjustment.

8-1-1 Speed loop gain

(1) Setting the speed loop gain

The speed loop gain 1 (SV005: VGN1) is an important parameter for determining the responsiveness of the servo control. During servo adjustment, the highest extent that this value can be set to becomes important. The setting value has a large influence on the machine cutting precision and cycle time.

[1] Refer to the following standard VGN1 graphs and set the standard VGN1 according to the size of the entire load inertia (motor and machine load inertia).

[2] If the standard VGN1 setting value is exceeded, the current command fluctuation will increase even if the speed feedback fluctuates by one pulse. This can cause the machine to vibrate easily, so set a lower value to increase the machine stability.

<When machine resonance does not occur at the standard VGN1>

Set the standard VGN1. Use the standard value if no problem (such as machine resonance) occurs. If sufficient cutting precision cannot be obtained at the standard VGN1, VGN1 can be raised above the standard value as long as a 70 percent margin in respect to the machine resonance occurrence limit is maintained. The cutting accuracy can also be improved by adjusting with the disturbance observer.

<When machine resonance occurs at the standard VGN1>

Machine resonance is occurring if the shaft makes abnormal sounds when operating or stopping, and a fine vibration can be felt when the machine is touched while stopped. Machine resonance occurs because the servo control responsiveness includes the machine resonance points. (Speed control resonance points occur, for example, at parts close to the motor such as ball screws.) Machine resonance can be suppressed by lowering VGN1 and the servo control responsiveness, but the cutting precision and cycle time are sacrificed. Thus, set a vibration suppression filter and suppress the machine resonance (Refer to section "4-4-2 Vibration suppression measures"), and set a value as close as possible to the standard VGN1. If the machine resonance cannot be sufficiently eliminated even by using a vibration suppression filter, then lower the VGN1.

【#2205】 SV005 VGN1 Speed loop gain 1

Set the speed loop gain.
The higher the setting value is, the more accurate the control will be, however, vibration tends to occur.
If vibration occurs, adjust by lowering by 20 to 30%.
The value should be determined to the 70 to 80% of the value at which the vibration stops.
The value differs depending on servo motors.
Aim at the standard value determined by the servo motor type and load inertia ratio to adjust.

---Setting range---
1 to 30000

POINT

1. Suppressing the resonance with the vibration suppression function and increasing the VGN1 setting is effective for adjusting the servo later.

2. When performing "Velocity loop gain adjustment" automatically with NC Analyzer for direct-drive motor system, select "Linear/DD motor (normal)" for "Velocity loop gain adjustment level" -> "Upper limit" in the Selection of adjustment item screen. If the adjusted VGN1 reaches the upper limit (=1000), select "Linear/DD motor (special)" and adjust it again.

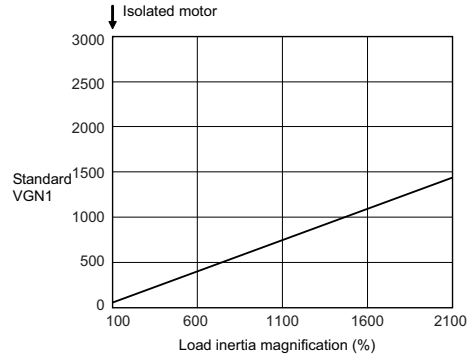
3. If "Gain Margin" or "Cross Frequency", the result of "Frequency response measurement" with NC Analyzer, displays "N/A" for the direct-drive motor system, the setting for VGN1 may be too small. Raise the setting value until the "N/A" display switches to a numerical value.

Load inertia ratio display

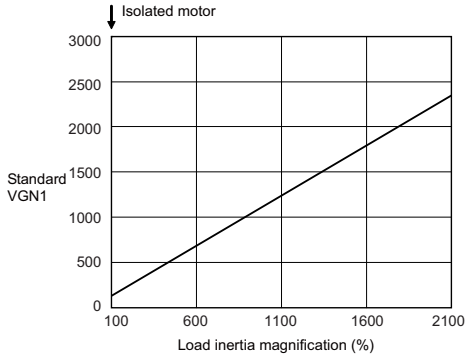
Perform the measurement referring to the section "(1) Measuring unbalance torque and frictional torque" of "Improvement of protrusion at quadrant changeover" in Instruction Manual of each drive unit, and set a torque offset (SV032) and frictional torque (SV045). When an acceleration/deceleration operation is executed with the setting of SV035/bitF=1, an estimated load inertia ratio will be displayed in "load inertia ratio " on the drive monitor screen.

Standard VGN1 graph (direct-drive motor TM-RB Series)
< MDS-D2 Series >

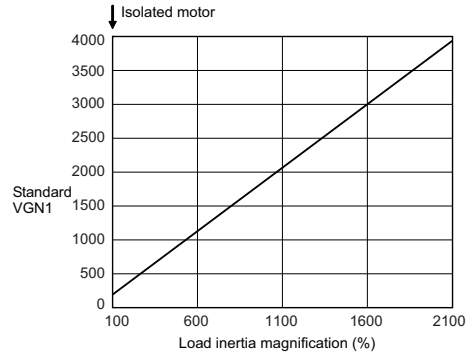
[TM-RBP012C20]



[TM-RBP036E20]



[TM-RBP048G20]



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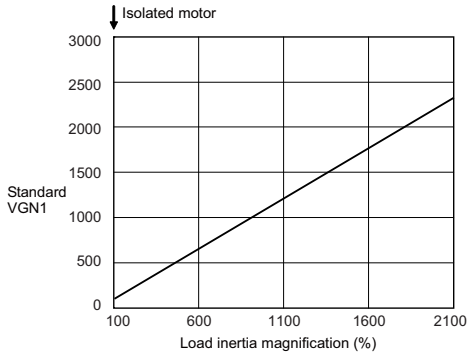

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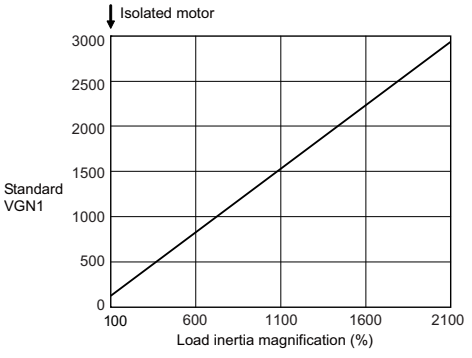

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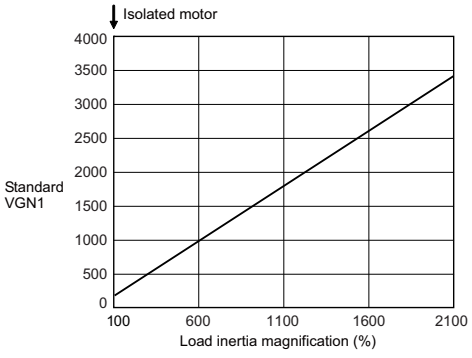
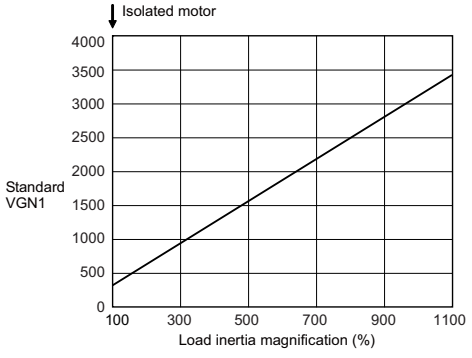


[TM-RBP340J20]



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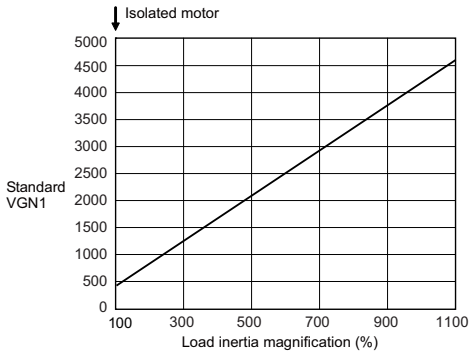
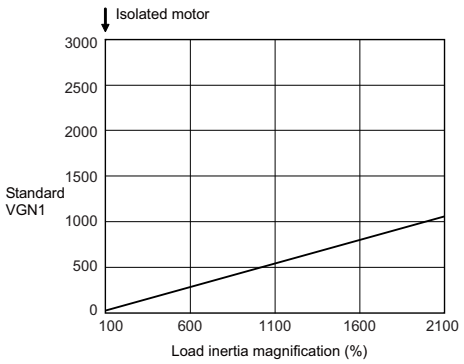


< MDS-DJ Series >

[TM-RBP012C20]



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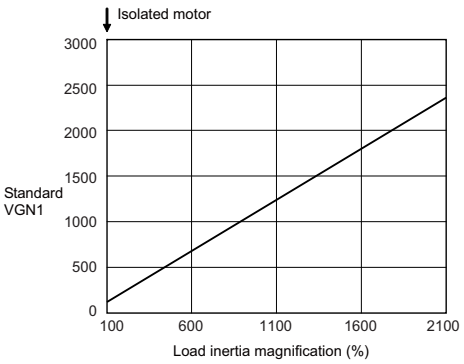

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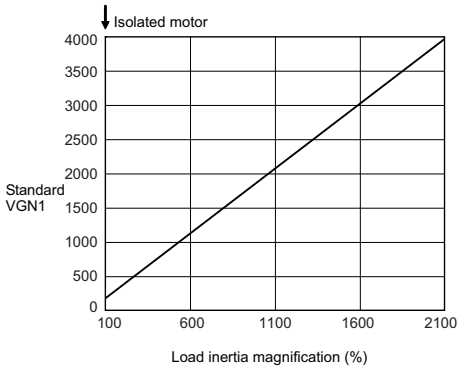

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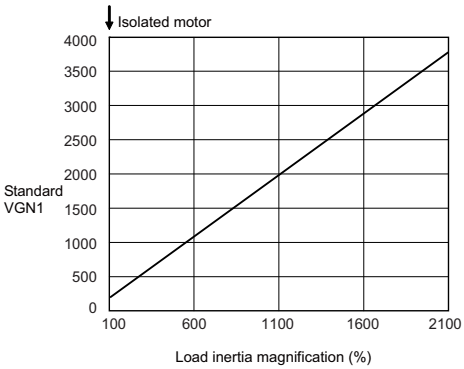

Revision History

Date of revision	Manual No.	Revision details
Jun. 2013	IB(NA)1501068-A	First edition created.
Aug. 2013	IB(NA)1501068-B	- "WARRANTY" was revised. - The explanation for CN3 was added to "Twin-head magnetic detector (MBA Series)". - MBA405W was added to “System configuration” and "Cable connection diagram". - The motor thermistor cable connection diagram was added to "List of cables and connectors". - "Grobal Service Network" was revised.

Global Service Network

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Notice

Every effort has been made to keep up with software and hardware revisions in the contents described in this manual. However, please understand that in some unavoidable cases simultaneous revision is not possible.
Please contact your Mitsubishi Electric dealer with any questions or comments regarding the use of this product.

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MITSUBISHI CNC

MITSUBISHI ELECTRIC CORPORATION
HEAD OFFICE : TOKYO BUILDING,2-7-3 MARUNOUCHI,CHIYODA-KU,TOKYO 100-8310,JAPAN

MODEL	Direct Drive Motor
MODEL CODE	100-375
Manual No.	IB-1501068

IB(NA)1501068(ENG)-B(1308)MEE
Made in JAPAN

Specifications are subject to change without notice.